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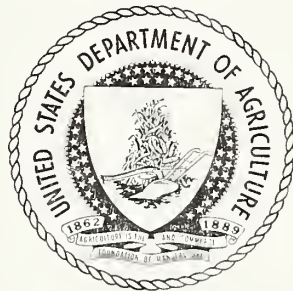
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PLANS

TIMBER MANAGEMENT PLAN  
BIG TIMBER WORKING CIRCLE  
GALLATIN NATIONAL FOREST  
MONTANA  
1961



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TIMBER MANAGEMENT PLAN  
BIG TIMBER WORKING CIRCLE  
GALLATIN NATIONAL FOREST  
REGION ONE, MONTANA  
1961

A. TITLE AND APPROVAL SHEET

<u>Submitted by:</u>	<u>/s/ Donald E. Niven</u>	<u>7/31/61</u>
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	<u>/s/ Charles R. Joy</u>	<u>8/ 2/61</u>
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<u>Approved by:</u>	<u>/s/ George H. Duvendack</u>	<u>8/ 8/61</u>
	Forest Supervisor	
	<u>/s/ W. H. Johnson</u>	<u>8/17/61</u>
	Acting Regional Forester	
	<u>/s/ Edward P. Cliff</u>	<u>10/17/61</u>
	Acting Chief	

Reviewed by:

Regional Office

Timber Management	<u>/s/ GFW</u>	<u>8/15/61</u>
Recreation, Lands & Watershed Management	<u>/s/ EFB</u>	<u>8/16/61</u>
Range and Wildlife Mgt.	<u>/s/ WLE</u>	<u>8/16/61</u>
Engineering	<u>/s/ ALA</u>	<u>8/15/61</u>
Fire Control	<u>/s/ MET</u>	<u>8/16/61</u>
State and Private	<u>/s/ EHJ</u>	<u>8/15/61</u>

Research

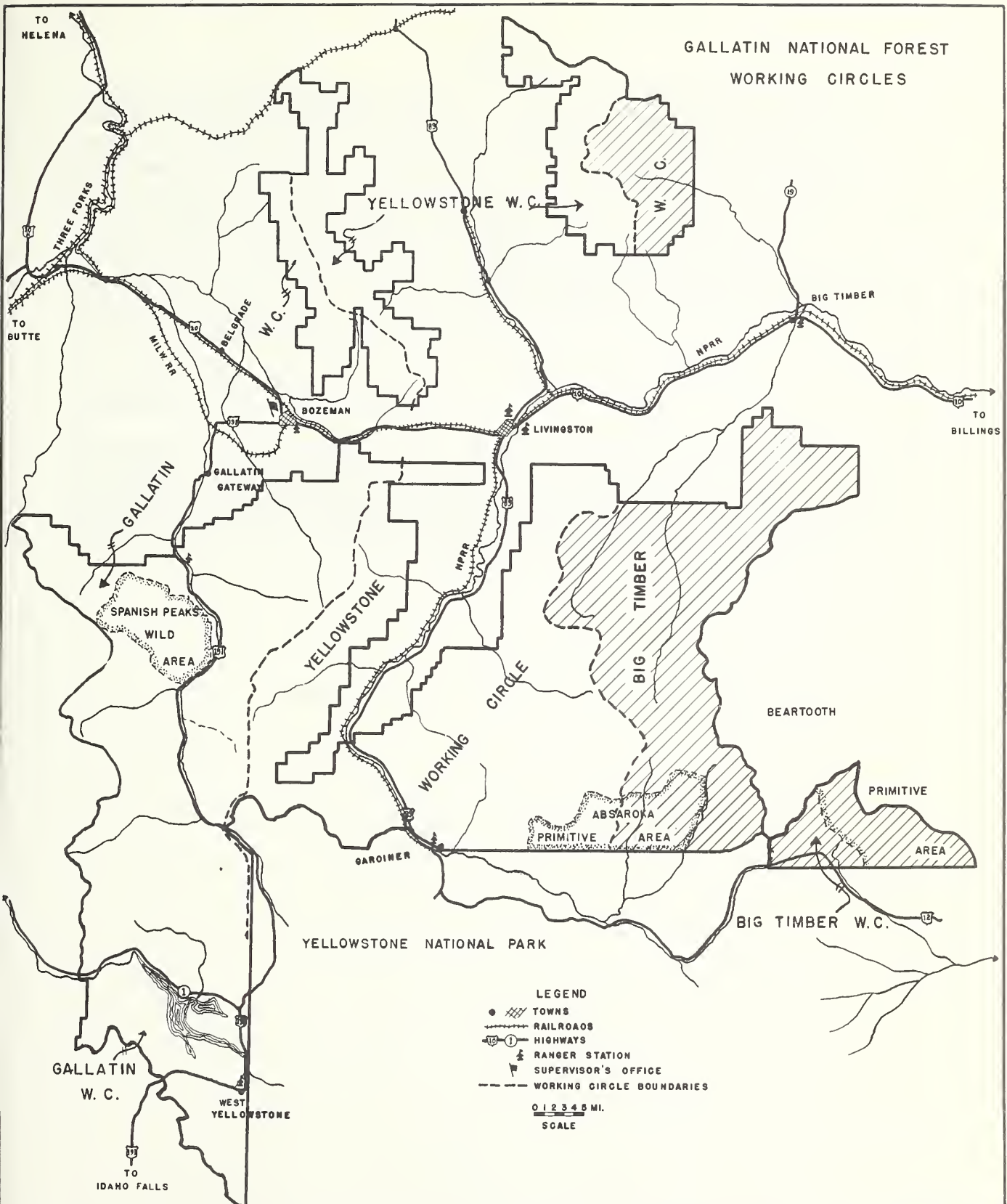
Forest Disease	<u>/s/ JWK</u>	<u>7/28/61</u>
Forest Insect	<u>/s/ DEP</u>	<u>7/28/61</u>
Forest Management	<u>/s/ CAW</u>	<u>7/28/61</u>

Washington Office

Timber Management	<u>/s/ DJM</u>	<u>10/17/61</u>
Multiple Use Coordination		



GALLATIN NATIONAL FOREST  
WORKING CIRCLES





## FOREWORD

Instructions from Congress provide, among other objectives, that the national forests shall be managed to furnish a continuous supply of timber for the use of citizens of the United States. Forest Service policy requires the development and application of sustained yield management of the national forests, working circle by working circle, as provided for in the Multiple Use-Sustained Yield Act of June 12, 1960. It is the purpose of this plan to apply the timber management policies and objectives of national forest administration growing out of related Federal laws and as currently set forth in the Forest Service Manual to the management of the timber resources of the national-forest lands within the Big Timber Working Circle of the Gallatin National Forest.

Basic data on area and volumes for the plan were collected and compiled during the years of 1959 and 1960.

The plan was prepared and written by Ralsh T. McAvoy and William R. Driver, Foresters, District Rangers Donald E. Niven and Charles R. Joy. General supervision was by George H. Duvendack, Forest Supervisor, and Dallas W. Beaman and Donald V. Williams, Timber Staff Officers. Technical direction was provided by the Division of Timber Management, Missoula, Montana.







## C. SUMMARY OF PLAN

### 1. AREA OF COMMERCIAL FOREST LAND

Ownerships			
National Forest (Nonreserved)	National Forest (Reserved)	Other Private	Total
----- Area in Acres -----			
127,259	19,345	11,310	157,914

### 2. TOTAL TIMBER VOLUME ON COMMERCIAL FOREST LAND

Ownership	Sawtimber MBF	Other Products M Cords
National Forest (Nonreserved)	650.1	955
Other Private	73.0	97
TOTAL	723.1	1,052

### 3. ANNUAL ALLOWABLE CUT (Nonreserved National-Forest Land)

Forest Type	Volume		
	Area	Sawtimber	Other
	Acres	MBF	Products M Cords
<u>Harvest Cut</u>			
D-P	500	3,000	3.7
LP	400	2,200	4.6
S-AF	400	2,800	3.7
TOTAL	1,300	8,000	12.0
<u>Intermediate Cut</u>			
All Types	800	1,700	1.2

### 4. GROWTH AND MORTALITY

	Sawtimber MMBF	Other Products M Cords
Periodic Net Annual Increment	1.5	8.4
Mortality	7.8	15.0
Sustained Yield Capacity	16.2	41.7

5. MAJOR PROBLEMS: Lack of suitable access roads and rights-of-way.

6. REVISION DATE: 1971



## D. MANAGEMENT PLAN

### 1. SUMMARY OF RESULTS UNDER PREVIOUS PLANS

There is in existence a timber management plan dated February 1, 1916, for the old Absaroka National Forest of which the Big Timber Working Circle is a part. However, none of the data contained in that plan is used in preparing this plan. While there are no large capacity processing plants in the working circle, it is believed that much of the timber from this working circle will be needed to supply the processing plants located at Livingston. The milling capacity there far exceeds the allowable cut from national-forest lands in that vicinity.

This working circle is almost totally undeveloped. This is an excellent time to put into operation a well-conceived management plan based upon an up-to-date inventory.

Present annual cut from this working circle is less than one-half million board feet.

### 2. LAND DESCRIPTION

The Big Timber Working Circle is located in four distinct parts consisting of (1) the headwaters and tributaries of the Boulder River, (2) the headwaters and tributaries of the Clark Fork of the Yellowstone River that lie in Montana, (3) the tributaries of the Yellowstone River east of the Hellroaring-Buffalo Divide and (4) the eastern slopes of the Crazy Mountains.

The working circle lies in Park, Sweetgrass, Stillwater, and Carbon Counties in south central Montana. All the area lies east of the Continental Divide.

#### a. Boundaries and Subdivisions

(1) The working circle is divided into two blocks which coincide with the boundaries of the Big Timber District and that part of the Gardiner District east of the Hellroaring-Buffalo Divide.

(2) Each block is divided into compartments. The Big Timber Block, which corresponds to the Big Timber District, is divided into 62 compartments numbered in the 100 series. The Gardiner Block, located in the eastern portion of the Gardiner District, has 17 compartments numbered in the 300 series.

Some of the larger watersheds have been broken up into two or more compartments.

#### b. Relation to Other Working Circles

This working circle is one of the three subdivisions of the Gallatin National Forest--the others being the Yellowstone and the Gallatin Working Circles. Most of the timber cut in the past from this working

circle has consisted of saw logs, fence poles and posts which have been marketed or used locally in the Big Timber area. However, nearby Livingston has been suggested as a site for a pulp mill, a chipboard plant, and a pres-to-log plant. In the event that these proposals become a reality, substantial volume of needed timber will come from this working circle. To supply the needed volumes, it will also be necessary to coordinate cutting budgets with other working circles on the Gallatin National Forest as well as the adjoining Lewis & Clark and Custer National Forests.

### 3. FOREST DESCRIPTION

#### a. Ownership

That portion of the Big Timber Working Circle in the Crazy Mountains is almost entirely in alternate section ownership. There is no one large principal owner other than national forest. The Boulder River portion of the Big Timber Block and all of the Gardiner Block are almost entirely in Federal ownership. (See table 1 below)

TABLE 1 - AREA BY LAND CLASS AND OWNERSHIP

Ownership	Total Area	Non-forest Land	Forest Land				
			Total	Non-commercial	Commercial		
					Total	Stocked	Non-stocked
				Acres			
National Forest (Nonreserved)	404,857	135,350	269,507	142,248	127,259	126,174	1,085
National Forest (Reserved)	98,169	53,140	45,029	25,684	19,345	19,345	-
Other Private	47,793	24,060	23,733	12,423	11,310	11,310	-
<b>TOTAL</b>	<b>550,819</b>	<b>212,550</b>	<b>338,269</b>	<b>180,355</b>	<b>157,914</b>	<b>156,829</b>	<b>1,085</b>

#### b. Forest Types

The major timber types are Douglas-fir, lodgepole pine, and subalpine fir. Table 2 shows the areas by types and size classes for nonreserved national-forest lands.



**TABLE 2 - COMMERCIAL FOREST LAND BY TYPE AND STAND-SIZE CLASS  
(NONRESERVED NATIONAL-FOREST LAND)**

Timber Type	Stand-size Classes					Total
	Sawtimber	Poles	Seedlings & Saplings	Subtotal Stocked	Non- stocked	
	----- Acres -----					
Douglas-fir	48,396	2,790	11	51,197	425	51,622
Ponderosa Pine	521	-	-	521	-	521
Lodgepole Pine	-	30,331	8,602	38,933	660	39,593
Spruce	3,536	-	-	3,536	-	3,536
Subalpine Fir	31,987	-	-	31,987	-	31,987
<b>TOTAL</b>	<b>84,440</b>	<b>33,121</b>	<b>8,613</b>	<b>126,174</b>	<b>1,085</b>	<b>127,259</b>

Douglas-fir - This type occupies 41 percent of the total commercial forest area available for management. The principal associate of Douglas-fir in this type is lodgepole pine.

Lodgepole Pine - The lodgepole pine type occupies 31 percent of the commercial forest area in the working circle. The principal associate species is Douglas-fir. Other associated species are spruce and subalpine fir which occur at higher elevations or on moist sites.

Subalpine Fir and Spruce - These types represent 28 percent of the commercial forest area. They generally occur at the higher elevations and on moist sites. Associated species are limber pine and lodgepole pine.

This table shows that 66 percent of the commercial forest area is classified as sawtimber and 26 percent as pole. The remaining area is classified as seedling and sapling or restocking. This reveals an unbalanced distribution of growing stock in the different size classes.

#### c. Stocking

Stocking averages slightly more than medium for the Douglas-fir type for all size classes. However, if the spruce budworm continues to increase in intensity and area, the stocking in this type will decrease. The lodgepole pine type is medium stocked. If the incidence of commandra rust continues, stocking in this type may be seriously affected. Alpine fir stocking is generally poor.

d. Volumes

Table 3 shows volumes by types, species, and size class (sawtimber and other products) for nonreserved national-forest land and for all types on private and other ownerships.

TABLE 3 - VOLUME OF SAWTIMBER BY TYPE AND SPECIES

Forest Type	Sawtimber & Pole Strata <u>Acres</u>	Sawtimber Volumes						Other
		P	D	S	AF	LP	Total	Products
		<u>MMBF (Scribner)</u>						<u>M Cords</u>
<u>NATIONAL FOREST</u>								
Douglas-fir	51,186	2.4	191.9	43.2	6.4	25.3	269.2	342
Ponderosa Pine	521	4.3	.5	-	-	-	4.8	2
Lodgepole Pine	30,331	-	16.3	16.2	5.2	116.9	154.6	319
Spruce	3,536	-	3.2	30.9	4.4	7.0	45.5	26
Subalpine Fir	31,987	-	-	71.5	44.6	59.9	176.0	266
Total	117,561	6.7	211.9	161.8	60.6	209.1	650.1	955
-----								
<u>OTHER OWNERSHIPS</u>								
All Types	11,310	.5	42.0	9.6	2.2	18.7	73.0	97
-----								

The sawtimber volume on national-forest lands is estimated to be 650 MM board feet + 58.5 MMBF two times out of three; i.e., the inventoried volume of 650 MMBF may be expected to be within 58.5 MMBF of the true volume on the working circle two times out of three. The volume of sawtimber in other ownerships is approximately 73 MM board feet.

Volume by species ranks in the following order: Douglas-fir, lodgepole pine, spruce, subalpine fir and ponderosa pine.

e. Thrift

The thrift of the Douglas-fir in the Crazy Mountains and the northern one-third of the Boulder unit of the working circle has been seriously impaired by the spruce budworm.

Thrift is generally declining in the lodgepole pine, spruce, and subalpine fir types because of overmaturity and disease, principally comandra rust and red rot.

#### f. Sites

Table 4 shows the area of site classes by forest types for nonreserved national-forest lands. These data were obtained by sampling procedures and are subject to errors incident thereto.

TABLE 4 - SITE CLASSES BY FOREST TYPES

Forest Type	Good		Medium		Poor		Total
	Acres	Percent	Acres	Percent	Acres	Percent	
Douglas-fir and Ponderosa Pine	-	-	3,129	6	49,014	94	52,143
Lodgepole Pine	6,731	17	17,025	43	15,837	40	39,593
Spruce and Subalpine Fir	-	-	6,039	17	29,484	83	35,523
<b>TOTAL</b>	<b>6,731</b>		<b>26,193</b>		<b>94,335</b>		<b>127,259</b>

The Douglas-fir type, as is true with most working circles east of the Continental Divide, is found on the poorer sites. Lodgepole pine type, on the other hand, is located on some of the better sites. Spruce and subalpine fir types are found mostly on poor sites.

#### g. Age Classes

In the Douglas-fir and ponderosa pine types, the age classes seem to fall in the 60-160 year age classes with only a small acreage in the 200+ class.

The lodgepole pine type is better distributed with nearly two-thirds of the growing stock less than 100 years of age. (See appendix table 18 for details of age class data)

#### h. Timber Quality

As a part of the inventory, sample growth trees were graded on each plot to provide information on sawtimber quality. The following table summarizes the information collected:

TABLE 5 - LOG GRADES BY SPECIES

(NONRESERVED NATIONAL FOREST LANDS)

Species	Log Grades			
	1	2	3	4
	----- Percent -----			
Douglas-fir	-	3	19	78
Spruce	-	-	61	39
Subalpine Fir	-	-	41	59
Lodgepole Pine	-	14	37	49

Spruce shows 61 percent in log grade No. 3 and better, followed by 51 percent for lodgepole pine and 41 percent for subalpine fir. Douglas-fir is predominantly poor quality with only 22 percent in log grades 2 and 3.

To give a better picture of what each of the four log grades represents, a brief description follows:

Grade 1: Select - surface clear.

Grade 2: Shop - few knots, 50 percent surface clear.

Grade 3: Common - numerous pin, small or medium live knots.

Grade 4: Low Common - medium large and very large live or dead knots.

#### 4. MANAGEMENT OBJECTIVES

##### a. Community Support

Big Timber, with a population of 1,600, is the chief trading and shipping point within the working circle. Grey Cliff, Reed Point, McLeod, and Melville are smaller villages that contribute to community support through farming and ranching. Cooke City, located in the extreme southeast corner of the working circle and on the Gardiner District, is a small resort town.

Due to limited access, the manufacturing of lumber products has not contributed substantially to the local economy. At the present time, there are seven small sawmills within the circle's sphere of influence, with an annual mill capacity of approximately one and one-half million board feet. Most of these mills are dependent, almost entirely, on the limited private timber found within the area.



If and when access to Government timber is obtained, the local mills as well as the mills in the Livingston area, will be interested in any sale offerings. An increase in the amount of available stumpage would be justification for the small mill operators to expand their operations.

As the cutting of Government stumpage increases, the 25 percent return to the county for forest receipts and the 10 percent return for roads and trails will make a significant contribution to the local community. The capital investment necessary to harvest the Government timber, plus the jobs created, would give the local economy a badly needed boost.

b. Silvicultural Objectives

- (1) To obtain reproduction as soon as possible after the removal of timber.
- (2) To reproduce species best suited to the site.
- (3) To obtain and maintain optimum stocking conditions for good growth by making intermediate cuttings and by restocking where necessary.
- (4) Capture mortality and obtain complete utilization of the forest crops. Give priority of cutting to stands suffering heavy damage from insects and disease.
- (5) To produce trees of good form and quality.
- (6) As a general practice, pursue even-age management throughout the working circle.

c. Growing Stock Objectives

The distribution of age classes within this working circle is abnormal. This is usually the case with the wild unmanaged forest. Approximately 20 percent of the present growing stock is over rotation age. Less than 10 percent is presently within the 1-20 and 21-40 year age classes.

Objectives which will improve growing stock conditions are:

- (1) Older stands will be cut as fast as the allowable cut will permit.
- (2) Cutting will be done on an approximately equal area each year.
- (3) Regeneration on cutover areas will be obtained within 5 years.
- (4) Plant, if necessary, to improve stocking on nonstocked and understocked areas.
- (5) Thin stands which are overstocked.

## 5. COORDINATION WITH OTHER USES

### a. Recreation

This working circle has high recreational values. The popular Boulder River, Cooke City, and Northeast Entrance to Yellowstone National Park, and portions of the Absaroka and Beartooth Primitive Areas are contained within it.

During 1960 there were 187,000 park visitors that entered or left via the Northeast Entrance. An estimated 4,800 man-days were spent in the 119,000 acres of the primitive areas. Some 95,000 visits were made to the Boulder River drainage. A total of 50,200 recreation visitors visited the Crazy Mountains portion of the working circle.

All indications are that the number of visitors to Yellowstone National Park, the recreation users to the wilderness areas and other national-forest lands will increase rapidly in the years to come. There is an increasing demand to camp outside the park and away from congested areas prevalent within the park. Also, the public is desiring to camp within the national forests in order to escape the crowded conditions in cities and towns. This places additional emphasis on the consideration and development of the recreational value of this working circle.

In 1960 there were within this working circle, 51 special-use permits for occupancy, 10 campgrounds, and 2 developed picnic sites. There were 15 resorts and dude ranches or places with similar recreational services available on private lands within and adjacent to this working circle. Also, there are four organizational camps within the Boulder River area which maintain a full schedule of activities during June, July, and August. The total recreational visits made to the national-forest lands within this working circle were approximately 337,000 in 1960.

All of the above discussion points out the present recreational use within this working circle and indicates a strong potential recreational demand in the future. The National Forest Recreational Survey (NFRS) nearing completion will further emphasize the present use and potential demand for this area.

In order that the recreational use will retain its proper perspective under multiple-use management, the following practices will be observed in the harvest of the timber resources:

(1) Recreation plans, when available, will be correlated with timber harvest plans.

(2) In proposed sale areas where there is no recreational development plan available, the recreational potential will be fully considered to insure that the recreational value will not be destroyed.

(3) Areas having primary value for recreation will be delineated and timber harvesting and road building will be done in a manner that will not impair such values. The objective of timber management in roadside, streamside, and lakeside zones will be to maintain aesthetic values that will present attractive forest conditions to the recreational traveler.

(4) Care will be exercised in using existing roads and in the construction of new roads so that timber use does not result in the elimination of other uses of the road. Standards of construction will be based on the over-all use of the area the road serves.

b. Wildlife

Coordination of timber use with wildlife use will be guided by R-1 Supplement No. 87 dated August 1959, FSH 2632.1. At the present time, wildlife habitat management problems within the working circle are confined to the open grassland and brush types. When extensive cutting is started, a need for a study of the effects of wildlife concentrations on the cut areas and possible damage to reproduction may become necessary.

The timber cutting methods in even-age management generally consist of clear cutting in blocks of 10 to 50 acres in such a fashion that uncut timber areas surround the clear-cut areas. This practice has several advantages in wildlife management which include a well rounded habitat for big game animals and upland game birds. These relatively small clearings, surrounded by uncut timber, provide a desirable combination of feed and cover for all classes of game.

The road building program, in conjunction with the increased timber utilization, will provide hunters and fishermen access to large areas not easily reached by foot or horseback. The increased distribution of hunting pressure will result in better game management and increase the volume and value of game available to the public. (FSH 2413.24, supp. No. 275)

c. Grazing

Grazing is presently one of the most important resources within this working circle. On the average, there are 2,089 head of cattle grazing approximately 6,315 animal months, and 11,720 head of sheep grazing approximately 20,623 animal months each year. In addition, 149 head of commercial pack stock graze approximately 205 animal months. Of the total gross area of 550,819 acres, there are approximately 107,142 usable acres for grazing purposes (excluding acres in game range and wilderness area).

In view of the importance of grazing in this unit, no artificial means will be used to increase the acreage of forest land at the cost of decreasing the acreage of grassland. It will be the policy to maintain the acreage of the two types of land use in status quo and concentrate more on improving the productivity of the two types of land for present



use. Although there are many grazing problems within the working circle, there is little conflict with timber production. Opening up the timber stands by cutting may temporarily increase the amount of forage available and result in increased temporary use for grazing unless conflicts with timber reproduction develop. Roads constructed on sale areas will be considered from the standpoint of beneficial and detrimental effects on livestock distribution and management. Where conflicts are probable, provisions will be made for necessary cattle-guards and fences in appraisals and sale contracts.

d. Mining

The working circle has a large number of mining claims in existence. These claims are concentrated in the Cooke City area of the Gardiner Block and around the old mining town of Independence in the Big Timber Block. In the Cooke City area alone there are approximately 172 patented and 225 unpatented claims. With respect to timber management, there are presently no conflicts between mining claims and efficient administration of the national-forest lands. However, the presence of these claims must be recognized in future timber developments. The problem of access, due to lack of rights-of-way through patented claims, may arise especially in the Cooke City area. Surface rights determinations under Public Law 167 have been completed in several areas and are under way in several more.

e. Water

One of the most important contributions of national forests to the western economy is water. All national-forest lands, whether forested or open range, have important watershed values.

More than 45,000 acres of irrigated farmland in Sweet Grass County are dependent upon water stored in the forested areas within the working circle. It is estimated that 150,000 acre-feet of irrigation water is used within the county each year.

Also, thousands of acres of farmland down the Yellowstone Valley are dependent, in part, upon water that originates within the working circle. In addition, the city of Big Timber is directly dependent upon the national forest for its domestic water supply, the entire amount being taken from the Boulder River.

Timber cutting practices must be closely watched to maintain the highest possible quantity and quality of water in all streams on the working circle.

Some of the specific things that will be done to improve watershed management on timber sale and other areas are:

- (1) Fell streamside trees which must be cut away from the stream.
- (2) Keep logging and road building debris out of stream and out of reach of high water.

- (3) When building roads in and below logging areas, be sure that bridges and culverts are large enough to carry unusually high flows and so constructed to minimize the probability of plugging with debris.
- (4) Road construction should not restrict channels nor put loose materials in places where it is likely to be carried away by running water.
- (5) Accepted measures for preventing erosion on roads, skid trails, landings, and burns will be followed and will be specified in timber sale contracts.
- (6) Watershed considerations may dictate that marginal stands on steep slopes or very poor sites are better left as protective cover.
- (7) Peak flow measurements will be taken for the purpose of estimating bridge and culvert specifications capable of handling probable discharges.
- (8) Further research is needed to determine the local effects of various timber harvest methods on streamflow and sedimentation.

#### f. Experimental Forests

There are no experimental forests within the working circle, but there is a Lodgepole Pine Research Center which has recently been located at Bozeman. As activities increase in scope at this research center, many of the problems within the lodgepole pine type will be studied. No doubt, some study areas will be established within this working circle.

There is an increasing need for both basic and applied research in the lodgepole pine type in particular, and in east-side types in general.

### 6. REGULATION

#### a. Rotation

Rotations adopted for each of the major forest types agree closely with the culmination of mean annual growth for the major products to be grown. They are as follows:

<u>Timber Type</u>	<u>Rotation Age</u>	<u>Primary Product</u>
Douglas-fir and Ponderosa Pine	160	Lumber
Lodgepole Pine	120	Lumber, pulp & poles
Spruce and Subalpine Fir	140	Lumber and pulp

The foregoing rotations apply mainly to stands now being regenerated. Some of the present stands will also be cut at the ages recommended, however, because of inaccessibility and overmaturity, many will have to be carried well beyond those ages before they are cut. Rotations recommended apply to average site conditions. Individual stands growing on poorer or better than average sites will require more or less time to mature, as the case may be.

#### b. Cutting Cycles

Generally, all major timber types will be managed for production of even-aged stands of timber. Under even-aged management, cutting cycles for harvest cuttings will coincide with length of rotation. Where improvement cuttings are needed in immature stands, intervals between cuttings will coincide as nearly as possible with periods of best growth response. This period is thought to be between 15 and 20 years. Intermediate cutting periods will be scheduled accordingly.

#### c. Growth and Mortality <sup>1/</sup>

Current net growth data expressed as averages for the past ten years are very low. For all types combined, it is only one and one-half million board feet per year, or an average of thirteen board feet per acre. (See table 6) This may be compared with the sustained yield capacity of 16 million board feet, or 89 board feet per acre annually.

Current growth rates by types are extremely variable. Douglas-fir and spruce show fair growth considering the site qualities involved. Lodgepole pine and subalpine fir actually show minus growth rates when mortality is considered. (See appendix table 15)

The very low growth rate at the present time is due mainly to the extremely high mortality in lodgepole pine. Unless wide scale efforts are made to control the more serious diseases of lodgepole pine, principally dwarfmistletoe and comandra rust, no net increase in growth may be expected. Actually, net growth is more apt to decline unless some control measures are taken. Studies made while inventory plots were being taken show that 17 percent of the lodgepole is now heavily infected with comandra rust. Growth of Douglas-fir will likely be less in future periods because of the severe budworm infestation now present.

Growth potentialities in the working circle are low. This is reflected by the site qualities, however, the potential is much above the present growth rate as is shown by the sustained yield capacity in table 6.

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<sup>1/</sup> Rates of periodic annual increment were obtained from mortality data covering a 5-year period and growth data obtained from borings for a 10-year period preceding the 1960 inventory. Mean annual increment rates were obtained by dividing total volumes of present stands by their average ages.



TABLE 6 - CURRENT AND POTENTIAL GROWTH OF SAWTIMBER AND OTHER PRODUCTS  
(NONRESERVED NATIONAL-FOREST LANDS)

Growth & Mortality	Sawtimber		Other Products		
	/acre/year	Total	/acre/year	Totals	
	BF	MBF	CF	MCF	M cds. <sup>5/</sup>
<u>Periodic Annual Increment (Net)</u> <sup>1/</sup> Past 10 years (1950-1959)	3/ 13	1,532	6.4	754	8.4
<u>Mortality (Annual 1955-1959)</u>	66	7,799	11.5	1,352	
<u>Sustained Yield Capacity</u> <sup>2/</sup> Normal (fully stocked)	4/ 127	16,187	30.0	3,756	41.7
Realizable (70 percent stocked)	4/ 89	11,308	21.0	2,633	29.3
<u>Mean Annual Increment</u> Average Stocking (present)	46	5,874	6.1	774	8.6

1/ From inventory data taken in 1960.

2/ From tables of Mean Annual Increment of Fully Stocked Stands in Major Forest Types of Region 1, U.S. Forest Service, Missoula, Montana, 1957.

3/ Rate for sawtimber and pole stands only - 117,561 acres.

4/ Prorated against total commercial forest area of 127,259 acres.

5/ 90 cubic feet = 1 cord

#### d. Methods of Cutting

Methods of cutting for each stand of timber in the working circle will be according to marking guides for forest types in Region One. Methods called for by the guides will be correlated with all important land uses and adjusted when necessary to accommodate those uses. They also will be supplemented by specific marking instructions for each timber sale area.

#### e. Annual Allowable Cut

Several regulatory methods were considered and used in setting the cut for the working circle. These were the Kemp, Von Mantel, Hanzlik, and Austrian formulae, and the Tabular Check method of ascertaining adequacy of growth and growing stock in supporting a predetermined level of cutting.

All five methods indicate that the cut in sawtimber should be close to 8 MM board feet, plus other products (table 7). Cutting at this rate will (1) gradually reduce the cutting age from about 200 years at present to rotation age by the end of the first rotation, (2) obtain rotations of the proper length, and (3) avoid premature cutting in any portion of the growing stock. It should also coincide rather well with area regulation requirements.

In addition to sawtimber, about 12,000 cords of other products will be available annually from 5" to 11" d.b.h. trees on harvest cutting areas (table 7). This material might represent as much as 2 MM board feet of small-size sawtimber if it becomes economical to harvest most of it as such.

Allowable annual cuts of sawtimber and other products are, therefore, set at 8 MM board feet and 12,000 cords, respectively, for the working circle for the next ten years.

TABLE 7 - ANNUAL ALLOWABLE CUT OF SAWTIMBER AND OTHER PRODUCTS

NATIONAL FOREST LANDS

Regulatory Method	Annual Cutting Area	All Types and Species		
		Sawtimber	Other Products	
	Acres	MBF	MCF	M Cords <u>1/</u>
Kemp	1,432	7,992	1,068	11.9
Von Mantel	-	7,903	1,098	12.2
Hanzlik	-	7,911	774	8.6
Austrian	-	7,565	-	-
Tabular Check	1,283	8,000	-	-

1/ 90 cubic feet = 1 cord

Annual allowable cuts by types are found in appendix tables 22 to 27. There is considerably more variability shown here than for all types combined, although it is not considered excessive. Apportionment of cut by types was made on the basis of the Kemp formula owing to its close agreement with the Tabular Check method and the fact that its values are midway between extremes. Table 8 shows adjusted total cuts for each type and cut by species according to representation in the sawtimber strata.

Table 8 also shows that harvesting operations should be conducted on 1,300 acres each year for the next ten years. This is in close agreement with the area designated for cutting during the initial ten years of the Tabular Check method and is within 10 percent of that indicated for annual cutting by the Kemp formula. Strict area control would allow only about 900 acres to be cut annually. Present age class distributions, mortality, and understocked conditions in sawtimber stands do not permit adherence to strict area control at this time.



TABLE 8 - ANNUAL ALLOWABLE CUTS FROM HARVEST CUTTINGS

NATIONAL FOREST LANDS

Timber Type	Annual Cutting Area	Annual Allowable Cut						Other Products
		Sawtimber						
		P	D	S	AF	LP	Total	
		- - - - -	MBF (Scribner) - - - - -					M Cords
D-P	500	70	2,080	490	80	280	3,000	3.7
LP	400	-	230	230	70	1,670	2,200	4.6
S	40	-	40	400	60	100	600	.3
AF	360	-	-	890	560	750	2,200	3.4
TOTAL	1,300	70	2,350	2,010	770	2,800	8,000	12.0

Apportionment of cut by blocks or districts will be subject to administrative adjustments by the forest supervisor from time to time to cope with silvicultural needs, accessibility, rights-of-way problems, and emergencies of various sorts. At the beginning of the plan period it will be according to table 9.

TABLE 9 - APPORTIONMENT OF ANNUAL ALLOWABLE CUT BY BLOCKS

Block	Annual Allowable Cut							
	Sawtimber				Other Products			
	LP	D-P	S-AF	Total	LP	D-P	S-AF	Total
	MBF				M Cords			
Big Timber	1,320	3,000	1,344	5,664	2.8	3.7	1.2	7.7
Gardiner	880	0	1,456	2,336	1.8	0	2.5	4.3
TOTAL	2,200	3,000	2,800	8,000	4.6	3.7	3.7	12.0

Allowable cuts will be controlled by area as well as by volume. Area will be controlling if the two get out of balance. It is also desirable to regulate cutting by types insofar as possible. Annual harvest will not exceed the annual allowable cut by more than 10 percent during the plan period. Undercuts may be accumulated during the planned period; however, the annual allowable cut may not be exceeded by more than 25 percent during any one year in order to liquidate such accumulated undercuts. (FSM 2412.12)

Volumes of dead trees resulting from endemic losses will not be charged against the allowable cut. Volumes harvested from epidemic or catastrophic losses must be charged against the allowable cut, as well as unsalvaged amounts of what formerly was inventoried as green growing stock. Revised allowable cuts should be recomputed as soon as practicable after catastrophic losses have occurred.

The allowable cut of material inventoried as salvage products has not been determined, nor is regulation of these products desired. The perishable nature of this material makes it desirable to harvest it in unlimited quantities whenever possible. Appendix table 21 shows volumes available for cutting.

The aforementioned cuts do not consider volumes that might be harvested as intermediate cuttings. Few such cuttings have been made to date in the working circle. There are indications, however, that markets for small-size products may develop soon and that sales can be made of this class of material in the near future.

Appendix table 27 shows areas of dense young stands that should be given intermediate cuttings annually and also volumes that may be removed in such cuttings. Area to be treated will be stressed rather than volume. The following is a summary of computed cuts by blocks:

Block	Annual Allowable Cut		
	Area to Cut	Sawtimber	Other Products
	Annually		
	Acres	MBF	M Cords
Big Timber	600	1,300	1,130
Gardiner	200	400	70
TOTAL	800	1,700	1,200

It is important to charge the volume cut against the right allowable cut category. Volume secured from harvest cuttings cannot be charged against intermediate cutting allowances or vice versa. Again, where utilization of mature sawtimber extends to size classes below 11" d.b.h.--and this generally is the case in both harvest and intermediate cuttings--an apportionment of the cut must be made to the appropriate category.

#### f. Cutting Budget

A cutting budget is established for each block and is shown in appendix tables 28, 29, and 30. This budget will cover a five-year period. Rangers on each district will revise the cutting budget annually by dropping a year and adding a year so there will always be a plan for the next succeeding five-year period. Due to inaccessibility, there are no plans for cutting on the Gardiner portion of this working circle within the next 5-year period.

In planning sales and setting up the cutting budget for each ranger district, the three major factors to be considered are:

First - The stands most in need of cutting in order to prevent excessive loss of volume from overmaturity, insects, disease, windthrow, and other depredations are to be placed first on the agenda. Thrifty mature stands should be postponed until a later date after all the high priority stands in need of cutting are harvested.

Second - A second factor to consider is access to timber. There are areas where the overmature condition of timber warrants cutting immediately. Due to the remoteness from existing roads, cutting may have to be postponed until road construction funds are provided. Progressive planning and a program of action are needed to back up the need for roads.

Third - The third factor concerns the securing of rights-of way across private lands. In conjunction with the five-year coordinated annual timber harvest and access road plan, a program for procurement of rights-of-way well in advance of the date of a proposed sale will be implemented. Such a program will be made part of this plan.

## 7. SALES POLICY

The sales policies established (FSM 2430) will be followed.

### a. General

- (1) Conduct sales in harmony with other uses.
- (2) Acquire rights-of-way for timber access roads.
- (3) Develop or improve the timber access road system in the working circle to permit orderly harvesting of forest products according to management prescriptions.
- (4) Control location and standards of logging roads and camps established in the working circle.
- (5) Prevent damage to residual growing stock.
- (6) Provide for adequate reproduction of desirable species.
- (7) Make adequate plans for expenditure of K-V funds for sale area betterment when appropriate to collect.
- (8) Reduce all fire hazards due to logging to acceptable limits or provide extra protection for the areas involved.
- (9) Protect the watershed by adequate control measures.



b. Size of Sales

Sale size will be governed by the following:

- (1) Natural unit boundaries of stands.
- (2) Access road requirements--including rights-of-way
- (3) Requirements of potential purchasers.

Both long- and short-term sales will be standard practice. Larger sales should be made in order to finance heavy development costs. Smaller sales are apt to be made after areas have been opened by access roads. Small sales should also be made to improve stands, market isolated bodies of ripe timber, salvage dead or dying timber, or to meet, if practical, the special needs of purchasers.

c. Merchantability Specifications

Regional merchantability specifications, as stated in FSH 2432.23, will be observed on all cutting operations.

d. Logging Methods

Control of logging methods will be required on all sales to prevent damage to the watershed and residual stands and to conform with limitations imposed by other uses. Tractor or jammer skidding and truck hauling will be the principal methods of logging. Skid trails will be on grades that will minimize erosion. They will not be permitted in streambeds. Streambanks will be protected. Felling or dragging timber across stream courses will be avoided when possible. Logging debris must be kept out of streams. Standard soil erosion requirements will be included in each sale contract. Salvage logging within roadside zones and recreation areas shall be done in a manner that will protect existing administrative and recreational values. A strip on each side of the stream will be carefully considered for special treatment to protect the watershed, recreation values, and fish habitat.

8. FOREST DEVELOPMENT

a. Transportation

(1) Present System - The working circle has a fair basic network of main highways. U.S. Highway No. 10 bisects the working circle from east to west through Big Timber, Montana. The Crazy Mountains portion of the working circle is tributary to State Route 19. The Boulder River drainage is reached by good to very poor county and Forest Service road running south from Big Timber. This road is not suitable for log hauling. The Gardiner portion of the working circle is tapped by Route No. 12, the famous Cooke City-Red Lodge highway, which leads to the Northeast Entrance of Yellowstone Park. Because of restrictions on hauling through Yellowstone Park, this route has little value as far as timber harvest is concerned.

The Northern Pacific Railway Company's main line runs east and west through Big Timber.

No portion of the working circle has an adequate transportation system at the present time. Adequate access roads and acquisition of rights-of-way constitute the biggest problem in managing the timber resources of this working circle.

(2) Needs - Following is a summary of the transportation needs as shown on the 1960 transportation plan:

MILES OF SYSTEM ROADS APPROVED TO JUNE 30, 1960

	<u>Satisfactory</u>	<u>Unsatisfactory</u>	<u>Nonexisting</u>	<u>Total Miles</u>
Type (A)	5.3	82.7	146.6	234.6
Type (U)	<u>.0</u>	<u>.0</u>	<u>113.6</u>	<u>113.6</u>
Total	5.3	82.7	260.2	348.2

An estimated 500 additional miles of IU roads will be needed to harvest the timber in the working circle.

(3) Policy - Timber access roads, having difficult construction or high construction costs relative to volume of timber to be moved over them in the first sales in the drainage, will be programed for construction with appropriated funds. Land utilization roads will be constructed by the timber purchaser where practical. All roads will be located and constructed using the Region One "Criteria for Forest Development Roads as Guides for Planning."

To avoid complications and any undue delay, rights-of-way will be obtained well in advance of advertising sales or preparing construction contract.

(4) Program - The three-year Coordinated Timber Harvest and Access Road Plan in the appendix shows the roads needed in the next three-year period. This plan will be revised annually according to instructions in the Forest Service Handbook.

The project which should be given priority in this working circle for construction from Federal funds is:

<u>Name of Road</u>	<u>Road No.</u>	<u>Mileage</u>	<u>Estimated Cost</u>
Main Boulder	212	22.9	\$ 623,000.00

b. Planting

(1) Needs - There are some 1,085 acres of nonstocked commercial forest land scattered throughout the working circle. This is about one percent of the total commercial timberland in the working circle.

(2) Policy - Planting will be done according to the R-1 Planting and Stand Improvement Handbook standards applicable to the east side.

It is regional policy to plant timber sale areas where needed to fill in where natural stocking cannot be expected within five years after cutting. K-V funds will be used for this work.

(3) Program - The cutting of clear-cut blocks of 10-50 acres in size has provided for adequate regeneration in most cases. A planting program will be set up to rehabilitate nonstocked areas, burned areas, and the logging areas which do not regenerate naturally.

As a part of the action program, a current cumulative record of plantable acres will be maintained. The annual planting program for the working circle will be made from this record in order of priority.

c. Timber Stand Improvement

(1) Needs - Timber stand improvement work needed in this working circle is listed as follows:

(a) Control of dwarfmistletoe and comandra rust.

(b) Removal of wolf trees and other unmerchantable defective trees which will interfere with regeneration and compete with established reproduction.

(c) Control of overstocking in young stands.

(d) Proper seedbed preparation.

(e) Removal of low-value species, such as subalpine fir.

(2) Policy - The policy will be to analyze timber stand improvement needs for each timber sale, make plans, collections, and perform the necessary work to provide for the needs.

(3) Program

(a) As appropriated funds become available for timber stand improvement in immature stands, an action program to improve quality and quantity of timber products will be implemented.



The program will consist of removing of dwarfmistletoe-infected stands, establishment of mistletoe-free reproduction, removal of less desirable species, and thinning of overstocked stands on the best sites first.

(b) A timber stand improvement plan will be prepared for each sale area which will provide for the most beneficial and practical use of available cooperative work funds.

d. Insect, Disease, and Rodent Control

(1) Problem - Through loss in increment and the direct killing of trees, much valuable timber is lost every year to insects, disease, and rodents. By using available mechanical control measures and suitable management practices, these losses can be reduced. Each problem is discussed separately under Item 3.

(2) Policy - Control measures will be undertaken only under epidemic conditions. Thorough study must be made to determine all the biological aspects of any proposed control project. Generally by applying appropriate cutting practices, much timber can be saved from infection and loss.

(3) Program - Be alert for new outbreaks of insect, disease, and rodent damage. Infected, infested, and damaged areas will be surveyed and information kept current as funds become available. Control projects will be initiated as needed. By speeding up the road right-of-way acquisition and road construction program, we can harvest stands which are now infected or damaged and thus save a portion of this high-risk timber. Also, by speeding up the road construction program, we will be able to harvest our timber as it matures and thus eliminate the source of some of our insect infestations.

Insects

Spruce Budworm - The spruce budworm has been present in endemic proportions on the Big Timber Working Circle for many years. It was reported as epidemic in the Crazy Mountains area as early as 1952. Serious defoliation was reported in 1955 and every year since.

By 1956, about 97,000 acres were infested in the Crazy Mountains area, about 20,000 acres in the West Boulder drainage and 42,000 acres in the Cherry Creek, Deer Creek, and Bridger Creek areas.

No control action has been taken in this working circle.

Douglas-fir sawtimber trees are dying in the Crazy Mountains area. Much of the younger age classes and understory have already been killed by the budworm.

Every effort should be made to set up a control project for these areas if biological evaluations show continued high populations. Mortality has not yet been serious in those areas south of Big Timber.

Bark Beetles (Mountain Pine Beetle, Douglas-fir Beetle, and Engelmann Spruce Beetle) - Damage caused by these beetles has been minor and scattered throughout the working circle. However, with the continuing budworm epidemic and increased amount of blowdown in our overmature lodgepole pine and spruce stands, future damage could become a major problem. Some areas in the Yellowstone and Gallatin drainages, which are seriously infested with budworm, reported large pockets of heavy Douglas-fir beetle attack in 1960. Harvesting the timber as it reaches maturity will do much to alleviate this problem.

#### Diseases

Dwarfmistletoe - There is evidence of dwarfmistletoe infection in nearly all of the lodgepole pine stands in the working circle. Research has initiated a survey of dwarfmistletoe occurrence in the working circle. Results should be available sometime during 1962. This parasite thrives in partially cut stands. Clear cutting in blocks appears to be the most effective means of control with the least expense. To supplement control work accomplished through harvesting, K-V money should be collected to be used for control within sale areas.

Comandra Blister Rust - This fungus has been known to be present in the lodgepole pine stands for many years. While the inventory plots were being taken, a concurrent survey showed that 17 percent of the lodgepole pine was heavily infected and 50 percent lightly infected with this rust. Additional surveys and studies should be made to determine extent of and control methods for this rust.

Peridermium (Hip Canker) - The primary host for this fungus is lodgepole pine. The disease spreads directly from tree to tree. Although its alternate host is commonly thought to be Indian paint brush, this is now questioned by some pathologists. The hip canker is prevalent in small areas but has not been reported as epidemic in the working circle.

Wood Fungus Diseases - Red rot causes extensive loss in overmature lodgepole pine stands. A heart rot is present in the old growth Douglas-fir which causes considerable loss. Our objective is to operate on a rotation age which will reduce such losses to a minimum.

#### Rodents

Porcupine Control - Porcupine damage is scattered throughout the working circle and does not present a serious problem at the present time. Should damage become serious, control will be instituted.



e. Fire Control

(1) Problem - During a normally dry summer, the forested areas of this working circle become highly inflammable. The combination of dehydrated combustible materials and lightning storms during such periods provides optimum conditions for starting and spreading of fires. The highest risk period is in July and August, frequently extending into September. Abnormal seasons have started as early as May and have extended through October.

Annual Losses - An analysis of the fire history for the years 1950-1960 shows 26 man-caused fires for 41 percent and 38 lightning-caused fires for 59 percent. A total of 64 fires burned 2,084.07 acres or an average of 189.46 acres per year. During this period, the largest man-caused fire was 0.5 acre and the largest lightning fire was 1,870 acres. This was the Horseshoe Basin fire in 1953.

The ~~par~~ for burned area on the Gallatin Forest is 0.12 percent for all area within the protective boundary. The analysis of fires during the eleven-year period indicates a very satisfactory fire record. With increased logging operations and increased recreational use on both private and public lands, the fire hazard will increase correspondingly, therefore, it is not wise to allow past fire records to lead land managers into complacency.

Policy - Through the proper use of approved fuel treatment methods, reduce the fire hazard on sale areas to a rating of medium-low, low-medium or less.

If partial slash disposal results in a fire hazard that is not adequately covered by the normal protection force, slash disposal funds may be collected to provide for additional protection for the period required to reduce the hazard to acceptable minimums.

Program - Timber sale contracts will contain clauses stipulating the fire protection requirements needed by the operator according to the regional standards and the State fire laws. These requirements will be conditioned to the methods of logging carried on in the working circle. Cutting by clear-cut blocks has been followed and is the method proposed for general use in the working circle. On clear-cut blocks, slash will usually be machine piled. These piles will be burned at such time when fire will not spread. When other types of logging are done, or where it is more feasible, the following fuel treatment methods may be used to reduce the fire hazard to the medium-low rate: lop and scatter, chipping, trampling, hand piling, and prescribed burning. In logging areas where snags if left would constitute a potential fire hazard, the snagging requirement will be included in the timber sale contract.

TABLE 10 - FIRE ANALYSIS - 1950-1960

Year	Total No. of Fires	Total Burned Acreage	Average Burned Acreage Per Fire	Man-caused		Lightning	
				No.	Percent	No.	Percent
1950	2	100.1	50.05	1	50	1	50
1951	2	.21	.11	1	50	1	50
1952	7	.16	.02	4	57	3	43
1953	7	1,873.60	267.66	3	43	4	57
1954	8	9.07	1.26	4	50	4	50
1955	6	.16	.03	3	50	3	50
1956	8	91.77	11.47	2	25	6	75
1957	8	.40	.05	3	38	5	62
1958	1	.10	.01	0	0	1	100
1959	5	.07	.01	4	80	1	20
1960	10	8.43	.84	1	10	9	90
TOTAL	64	2,084.07	32.56	26	41	38	59

f. Acquisition

The Crazy Mountains section of the working circle is in alternate section ownership. The railroad land-grant lands have been acquired by ranchers and other private owners. There are two small exchanges, involving about 3,000 acres, proposed in this area now. Blocking up of national forest holdings is highly desirable. Small ownerships of intermingled lands present serious right-of-way acquisition problems and, consequently, interfere with the orderly development of the timber resource. For right-of-way acquisition plan, see appendix tables 32 and 33.

9. COOPERATIONa. With Other Federal Agencies

Coordinate this plan, if needed, with the Missouri Basin comprehensive agricultural program. Cooperate with the Soil Conservation Service in watershed management problems. Work with Agricultural Stabilization and Conservation Committee on ACP programs as they pertain to timber management. Cooperate with any other agencies active within the working circle boundaries to the extent necessary for timber management needs.

b. With Montana State Forestry Department

Work with Montana State Forestry Department to promote sound management and wise use on all State and private lands within or adjacent to the working circle boundaries through the following cooperative programs: (1) fire control, (2) slash disposal, (3) insect and disease control, (4) cooperative forest management, (5) conservation reserve program, and (6) Title IV, Tree Planting.

c. With Other State Agencies

Cooperate with the State Fish and Game Department on coordination of wildlife problems and with other state agencies having projects within or adjacent to the working circle boundaries.

Cooperate with Montana State College in the sponsorship of research studies in timber management practices or related problems.

d. With Private Organizations

- (1) Cooperate with local sportsmen's organizations on fish and game management.
- (2) Cooperate with established recreational organizations.
- (3) Cooperate with local chambers of commerce on access road development and in creating and sustaining local industry.
- (4) Hold public hearings on controversial timber management problems and acquaint interested parties with the Forest Service plans, practices, and policies.

e. Demonstration Areas

Establish demonstration areas on national-forest lands to show timber management practices and proper land use. Demonstration areas will be adequately signed to tell the story of the activities being conducted.

10. OPERATION OF PLAN

a. Annual Plans

Annual plans will be made for the purpose of putting the plan to work on the ground. Access road development will have to be coordinated with the timber cutting budget. Timber surveys and timber sales stem directly from the cutting budget. Annual plans will be made to coordinate these activities with the guiding principles set forth in the main plan.

Other annual plans that will be prepared are planting plans, stand improvement, and sale area betterment plans.

b. Control Records

Control records will consist of tables and maps recording the following:

- (1) Records of timber sales will consist of name of purchaser, date, stumpage price by species, the market supplied, kind of products, location by compartment, and legal description.

(2) Control records will be maintained in accordance with FSH 2444.5.

(3) Planting record will show dates of establishment, species, age class planted and survival record.

(4) Intensive survey records will show detailed locations, acreage, date, and other pertinent information.

(5) Map showing location of compartments in working circle.

(6) Ownership map.

(7) Timber type map.

(8) Transportation plan map.

(9) Budgeted area map, with a color code and legend, showing compartments budgeted for cutting and stands most urgently in need of cutting.

(10) Sold area map indicating area sold.

(11) Cutover area map showing area cut.



## E. SUPPORTING DATA

### 1. HISTORY

The white man first entered this area with the Lewis and Clark expedition of 1806. As this area was rich in game and fur-bearing animals, many of the fur trappers roamed this country, but no records were kept.

With the discovery of gold in the Yellowstone Valley in the early 1860's, interest in the mineral deposits in this area was aroused. Gold was discovered in the Boulder River drainage in 1870. The resulting gold rush and population increase created a demand for agricultural and livestock products. Homesteads were filed, and the first permanent cattle herds were established in 1882. In 1883 the first bands of sheep arrived in the area.

To satisfy the demands for mining timbers and structural materials, sawmills were established in the Boulder River, Deer Creeks, and Crazy Mountain areas around 1890.

The lumbering industry continued to supply the local demand until the close of World War II. At this time, the demand for stumpage to meet expanding mill capacity in the Livingston area created greater interest in the timber resources of Sweet Grass County and the Big Timber Working Circle. However, due to lack of access to Government timber, the increased cutting was confined mostly to private timber with only a slight increase in cutting on public lands. A great deal of interest in timber on the Big Timber Working Circle exists, and competition for stumpage will be keen when suitable access is obtained.

### 2. PHYSIOGRAPHY

#### a. Topography

The Big Timber Working Circle has three major mountain ranges: The Crazy Mountains on the north, and the Absaroka and Beartooth Mountains on the south. The principal watersheds on the Big Timber District portion of the working circle are: The main Boulder River, with its tributaries, the East Boulder and West Boulder Rivers; Upper and Lower Deer Creeks, and the Bridger Creeks which flow north from the Absaroka Range to the Yellowstone River; Sweet Grass and Big Timber Creeks, flowing south from the Crazy Mountains to the Yellowstone River. On the Gardiner portion of the working circle the principal watersheds are: Buffalo Fork Creek and Slough Creek, flowing south from the Absaroka Range to the Lamar River in Yellowstone National Park; and the Clark Fork and its tributaries, flowing southeast from the Beartooth Mountains into Wyoming.

The topography varies from rolling foothills along the forest boundaries to steep slopes, sharp ridges, and some plateaus in the higher elevations. Elevations within the working circle range from 5,000 feet in the foothills to over 11,000 feet in the Absaroka, Crazy and Beartooth Mountains. The elevational range of commercial timber is from 5,000 feet to 8,500 feet.

The principal rock formations in both mountain ranges consist mainly of volcanic materials, with some conglomerate, sandstone, and shale areas. Most of the high country has been heavily glaciated by mountain glaciers.

Topography in general will permit the construction of a well-planned road network to harvest the timber. Excessive slopes and solid rock can, for the most part, be avoided.

#### b. Soils

Soil types are extremely variable due to changes in rock formation, climate, and vegetation. Glaciation has made soil parent materials complex in the higher mountains. Landslips may be associated with shale and glacial till areas. The erosion hazard is relatively high, chiefly because of climatic and soils characteristics of the area.

#### c. Climate

The climate in general of the working circle is similar to that of other mountain valleys of the northwest. Wide extremes of seasonal and daily temperatures are common to the area.

Prevailing winds are from the southwest. The coldest winds in winter are from the north or east. Thawing or "chinook" winds occur several times during the winter to evaporate and settle the snow.

Snowfall in the higher elevations averages about 60 inches, with the greatest amounts falling during December, January, and March. The greatest accumulation is found in March and early April. Average annual precipitation for Big Timber is 14.6 inches. Higher elevations have an average of 16-30 inches. The average for the working circle would be about 16.5 inches.

The mean annual temperature at Big Timber is approximately 46 degrees, with temperatures ranging from an average of 26.2 degrees in January to 70.0 degrees in July. Extremely cold periods (-20° to -30°) are seldom more than a week's duration. The Big Timber area has an average of 130 frost-free days from about May 10 to September 20. The average spring breakup period, insofar as logging is concerned, is about two months, occurring during April and May.

### 3. ECONOMY

The area within the Big Timber Working Circle has been operating on a well-established agricultural economy for many years. Cattle and sheep ranching and grain farming comprise this economy. The town of Cooke City, situated at the northeast entrance of Yellowstone Park and in the extreme southeast corner of the working circle, is dependent entirely upon the tourist trade.

Although of considerable potential, forest industries have not contributed materially to this economy. A great demand for Government stumpage in this area exists; and as access is provided, the timber industry will become a very important and permanent part of the economy of Sweet Grass County.

APPENDIX

BIG TIMBER WORKING CIRCLE

TIMBER MANAGEMENT PLAN





## INVENTORY TECHNIQUE AND ACCURACY

Data for the inventory of this plan are based on instructions issued by Region One in 1955 and 1956 and on "Field Instructions for Forest Inventory" prepared by the Intermountain Forest and Range Experiment Station. In brief, the following technique was followed:

1. Aerial photointerpretation of the various strata (forest type and condition classes).
2. On-the-ground checking of these classifications. (Done in 1959)
3. Transfer of strata classifications to a 2-inch-to-a-mile planimetric map.
4. Area calculation by strata. (Done in 1960)
5. Sampling each important strata ( 5,000 acres or more) to established standards. (Done in 1960)
6. Testing the statistical accuracy of the data.

## RELIABILITY OF THE DATA

There are two sources of error in determining the acreage and volumes of the various cover types and strata:

1. Technique errors - Those made in measuring, recording, and compiling sample plot, acreage, and volume data. These errors are minimized by thorough training and checking individuals responsible for the work.
2. Sampling errors - Those associated with the measurement of a sample of a population and applying the findings to the whole. Sampling was of such intensity on this unit as to hold the standard error to 9 percent, two times out of three. This is well within the  $\pm 10$  percent minimum established by memorandum of March 6, 1956. Sampling errors for the individual strata varied from 15 to 36 percent as shown by the attached data. The total sampling error for the working circle is estimated to be  $\pm 19.8$  MM cubic feet (9 percent of inventory), two times out of three.

The field data on the Big Timber Working Circle were collected by Ralph T. McAvoy, Forester, with the aid of trained assistants.

Statistical accuracy and the coefficient of variation for the major types in the Big Timber Working Circle are as follows:

COEFFICIENT OF VARIATION & STANDARD ERROR BY STRATA

Strata	Coefficient of Variation	Sampling Error (1 SD)
	Percent	Percent
D9W	38	17
D9M	78	29
D9P	68	24
-----		
AF9P	46	27
-----		
S9P	34	20
-----		
LP8W	40	15
LP8M	81	36
-----		
TOTAL		9

TOTAL LAND AREA BY OWNERSHIP

Appendix Table 1

Big Timber Working Circle

Block and Working Circle	Total Land Area <u>Acres</u>	National Forest			State Acres	Other Public	Forest Industry	Other Private
		Total	Nonreserved	Reserved				
Big Timber	373,199	329,000	329,000	-	-	-	-	44,199
Gardiner	177,620	174,026	75,857	98,169	-	-	-	3,594
<b>TOTAL</b> Big Timber Working Circle	550,819	503,026	404,857	98,169	-	-	-	47,793

TOTAL LAND AREA BY MAJOR LAND CLASSES

Appendix Table 2

Big Timber Working Circle

Block and Working Circle	Total Acres	Non-Forest Land (acres)	Forest Land (acres)				
			Total	Non-commercial	Commercial		
					Total	Stocked	Non-stocked
<u>Big Timber Block</u>							
Nat'l Forest Nonres.	329,000	112,328	216,672	119,947	96,725	96,156	569
Other Private	44,199	22,561	21,638	11,819	9,819	9,819	-
Total	373,199	134,889	238,310	131,766	106,544	105,975	569
-----							
<u>Gardiner Block</u>							
Nat'l Forest Nonres.	75,857	23,022	52,835	22,301	30,534	30,018	516
Nat'l Forest Res.	98,169	53,140	45,029	25,684	19,345	19,345	-
Other Private	3,594	1,499	2,095	604	1,491	1,491	-
Total	177,620	77,661	99,959	48,589	51,370	50,854	516
-----							
<u>Big Timber W.C.</u>							
Nat'l Forest Nonres.	404,857	135,350	269,507	142,248	127,259	126,174	1,085
Nat'l Forest Res.	98,169	53,140	45,029	25,684	19,345	19,345	-
Other Private	47,793	24,060	23,733	12,423	11,310	11,310	-
TOTAL	550,819	212,550	338,269	180,355	157,914	156,829	1,085



**COMMERCIAL FOREST LAND BY TYPE, STAND-SIZE CLASS, AND STOCKING**  
(Nonreserved National Forest Land)

Appendix Table 3

Big Timber Working Circle

Block and Working Circle	Forest Type	Sawtimber			Poletimber			Seedling and Sapling			Non-Stocked			
		Total Area	Total	Well	Stocking		Total	Well	Med.	Poor				
					Med.	Poor								
												Acres		
Big Timber Block	D	51,622	48,396	7,158	15,986	25,252	2,790	2,114	624	52	11	-	425	
	P	521	521	-	-	521	-	-	-	-	-	-	-	
	LP	27,527	-	-	-	-	18,892	10,870	5,685	2,337	8,491	7,723	213	
	AF	14,282	14,282	-	3,410	10,872	-	-	-	-	-	-	-	
	S	2,773	2,773	-	1,415	1,358	-	-	-	-	-	-	-	
Total		96,725	65,972	7,158	20,811	38,003	21,682	12,984	6,309	2,389	8,502	7,734	569	
Gardiner Block	LP	12,066	-	-	-	-	11,439	1,923	4,843	4,673	111	76	35	516
	AF	17,705	17,705	-	4,868	12,837	-	-	-	-	-	-	-	
	S	763	763	-	574	189	-	-	-	-	-	-	-	
		30,534	18,468	-	5,442	13,026	11,439	1,923	4,843	4,673	111	76	35	516
		-	-	-	-	-	-	-	-	-	-	-	-	-
Big Timber Working Circle	D	51,622	48,396	7,158	15,986	25,252	2,790	2,114	624	52	11	11	-	425
	P	521	521	-	-	521	-	-	-	-	-	-	-	-
	LP	39,593	-	-	-	-	30,331	12,793	10,528	7,010	8,602	7,799	590	660
	AF	31,987	31,987	-	8,278	23,709	-	-	-	-	-	-	-	-
	S	3,536	3,536	-	1,989	1,547	-	-	-	-	-	-	-	-
TOTAL		127,259	84,440	7,158	26,253	51,029	33,121	14,907	11,152	7,062	8,613	7,810	590	1,085

**NET VOLUME (BOARD FEET) SAWTIMBER-SIZE TREES BY SPECIES AND OWNER**  
**(In Pole and Sawtimber Stands - Stocked Nonreserved Commercial Forest)**

**Appendix Table 4**

**Big Timber Working Circle**

Block and Working Circle	Owner	Stocked Commercial (acres)	Total Volume (MBF)	Volume by Species - MBF						
				WP	P	L-D	S	H-AF-GF	LP-WLP	C
Big Timber Block	National Forest	96,156	503,669	-	6,682	206,975	107,895	32,946	149,171	-
	Other Private	9,819	66,283	-	528	41,575	7,461	1,258	15,461	-
	Total	105,975	569,952	-	7,210	248,550	115,356	34,204	164,632	-
Gardiner Block	National Forest	30,018	146,454	-	-	4,987	53,939	27,657	59,871	-
	Other Private	1,491	6,757	-	-	476	2,130	908	3,243	-
	Total	31,509	153,211	-	-	5,463	56,069	28,565	63,114	-
Big Timber Working Circle	National Forest	126,174	650,123	-	6,682	211,962	161,834	60,603	209,042	-
	Other Private	11,310	73,040	-	528	42,051	9,591	2,166	18,704	-
	TOTAL	137,484	723,163	-	7,210	254,013	171,425	62,769	227,746	-

NET VOLUME (PARTIAL CUBIC FEET) SAWTIMBER-SIZE TREES BY SPECIES AND OWNER  
(In Pole and Sawtimber Stands - Stocked Nonreserved Commercial Forest)

Appendix Table 5

Big Timber Working Circle

Block and Working Circle	Owner	Stocked Commercial (acres)	Total Volume (MCF)	Volume by Species (MCF)						
				WP	P	I-D	S	H-AF-GF	LP-WLP	C
<u>Big Timber Block</u>	National Forest	96,156	104,100	-	823	42,988	21,600	6,853	31,836	-
	Other Private	9,819	13,735	-	63	8,644	1,456	284	3,288	-
	Total	105,975	117,835	-	886	51,632	23,056	7,137	35,124	-
	- - - - -	-	-	-	-	-	-	-	-	-
<u>Gardiner Block</u>	National Forest	30,018	30,414	-	-	1,023	10,871	5,711	12,809	-
	Other Private	1,491	1,405	-	-	97	426	191	691	-
	Total	31,509	31,819	-	-	1,120	11,297	5,902	13,500	-
	- - - - -	-	-	-	-	-	-	-	-	-
<u>Big Timber Working Circle</u>	National Forest	126,174	134,514	-	823	44,011	32,471	12,564	44,645	-
	Other Private	11,310	15,140	-	63	8,741	1,882	475	3,979	-
	TOTAL	137,484	149,654	-	886	52,752	34,353	13,039	48,624	-
	- - - - -	-	-	-	-	-	-	-	-	-

NET VOLUME (PARTIAL CUBIC FEET) POLE-TIMBER-SIZE TREES BY SPECIES AND OWNER  
(In Pole and Sawtimber Stands - Stocked Nonreserved Commercial Forest.)

Appendix Table 6

Big Timber Working Circle

Block and Working Circle	Owner	Stocked Commercial (acres)	Total Volume (MCF)	Volume by Species (MCF)					
				WP	P	L-D	S	H-AF-GF	LP-WLP
<u>Big Timber Block</u>	National Forest	96,156	63,402	-	106	23,160	10,978	8,352	20,806
	Other Private	9,819	7,597	-	8	4,291	695	458	2,145
	Total	105,975	70,999	-	114	27,451	11,673	8,810	22,951
<u>Gardiner Block</u>	National Forest	30,018	22,526	-	-	249	6,493	6,816	8,968
	Other Private	1,491	1,125	-	-	22	256	236	611
	Total	31,509	23,651	-	-	271	6,749	7,052	9,579
<u>Big Timber Working Circle</u>	National Forest	126,174	85,928	-	106	23,409	17,471	15,168	29,774
	Other Private	11,310	8,722	-	8	4,313	951	694	2,756
	TOTAL	137,484	94,650	-	114	27,722	18,422	15,862	32,530



NET VOLUME (PARTIAL CUBIC FEET) POLE AND SAWTIMBER-SIZE TREES BY SPECIES AND OWNER 1/  
(In Pole and Sawtimber Stands - Stocked Nonreserved Commercial Forest)

Appendix Table 7

Big Timber Working Circle

Block and Working Circle	Owner	Stocked Commercial (acres)	Total Volume (MCF)	Volume by Species (MCF)						
				WP	P	L-D	S	H-AF-GF	LP-WLP	C
<u>Big Timber Block</u>	National Forest	96,156	167,502	-	929	66,148	32,578	15,205	52,642	-
	Other Private	9,819	21,332	-	71	12,935	2,151	742	5,433	-
	Total	105,975	188,834	-	1,000	79,083	34,729	15,947	58,075	-
<u>Gardiner Block</u>	National Forest	30,018	52,940	-	-	1,272	17,364	12,527	21,777	-
	Other Private	1,491	2,530	-	-	119	682	427	1,302	-
	Total	31,509	55,470	-	-	1,391	18,046	12,954	23,079	-
<u>Big Timber Working Circle</u>	National Forest	126,174	220,442	-	929	67,420	49,942	27,732	74,419	
	Other Private	11,310	23,862	-	71	13,054	2,833	1,169	6,735	
	TOTAL	137,484	244,304	-	1,000	80,474	52,775	28,901	81,154	

1/ Summary of tables 5 and 6.

**NET VOLUME (BOARD FEET) SAWTIMBER-SIZE TREES BY STRATA**  
**(Pole and Sawtimber Stands - Nonreserved National-Forest Lands)**

**Appendix Table 8**

**Big Timber Working Circle**

Strata	Stocked Commercial (acres)	Total Volume (MBF)	Volume by Species (MBF)					
			WP	P	L-D	S	H-AF-GF	LP-WLP
D9W	7,158	77,309	-	-	68,717	717	-	7,875
D9M	15,986	100,724	-	-	49,557	39,971	6,398	4,798
D9P	25,252	83,238	-	2,410	65,649	2,528	-	12,651
D8W	2,114	6,342	-	-	6,342	-	-	-
D8M	624	1,563	-	-	1,563	-	-	-
D8P	52	78	-	-	78	-	-	-
Total	51,186	269,254	-	2,410	191,906	43,216	6,398	25,324
P9P	521	4,793	-	4,272	521	-	-	-
LP8W	12,793	110,018	-	-	12,793	2,556	1,279	93,390
LP8M	10,528	34,742	-	-	-	11,579	3,158	20,005
LP8P	7,010	9,838	-	-	3,516	2,105	701	3,516
Total	30,331	154,598	-	-	16,309	16,240	5,138	116,911
AF9M	8,278	45,539	-	-	-	24,006	9,106	12,427
AF9P	23,709	130,412	-	-	-	47,431	35,563	47,418
Total	31,987	175,951	-	-	-	71,437	44,669	59,845
S9M	1,989	26,652	-	-	1,989	19,492	2,387	2,784
S9P	1,547	18,875	-	-	1,237	11,449	2,011	4,178
Total	3,536	45,527	-	-	3,226	30,941	4,398	6,962
GRAND TOTAL	117,561	650,123	-	6,682	211,962	161,834	60,603	209,042

**NET VOLUME (BOARD FEET) SAWTIMBER-SIZE TREES BY STRATA**  
**(Pole and Sawtimber Stands - Nonreserved National-Forest Lands)**

Appendix Table 8A

Big Timber Block

Strata	Stocked Commercial (acres)	Total Volume (MBF)	Volume by Species - (MBF)						
			WP	P	L-D	S	H-AF-GF	LP-WLP	C
D9W	7,158	77,309	-	-	68,717	717	-	7,875	-
D9M	15,986	100,724	-	-	49,557	39,971	6,398	4,798	-
D9P	25,252	83,238	-	2,410	65,649	2,528	-	12,651	-
D8W	2,114	6,342	-	-	6,342	-	-	-	-
D8M	624	1,563	-	-	1,563	-	-	-	-
D8P	52	78	-	-	78	-	-	-	-
Total	51,186	269,254	-	2,410	191,906	43,216	6,398	25,324	-
P9P	521	4,793	-	4,272	521	-	-	-	-
LP8W	10,870	93,480	-	-	10,870	2,171	1,087	79,352	-
LP8M	5,685	18,760	-	-	-	6,251	1,705	10,804	-
LP8P	2,337	3,289	-	-	1,177	701	234	1,177	-
Total	18,892	115,529	-	-	12,047	9,123	3,026	91,333	-
AF9M	3,410	16,762	-	-	-	9,889	3,751	5,122	-
AF9P	10,872	59,802	-	-	-	21,750	16,308	21,744	-
Total	14,282	78,564	-	-	-	31,639	20,059	26,866	-
S9M	1,415	18,961	-	-	1,415	13,867	1,698	1,981	-
S9P	1,358	16,568	-	-	1,086	10,050	1,765	3,667	-
Total	2,773	35,529	-	-	2,501	23,917	3,463	5,648	-
BLOCK TOTAL	87,654	503,669	-	6,682	206,975	107,895	32,946	149,171	-

**NET VOLUME (BOARD FEET) SAWTIMBER-SIZE TREES BY STRATA**  
**(Pole and Sawtimber Stands - Nonreserved National-Forest Lands)**

Gardiner Block

Appendix Table 8B

Strata	Stocked Commercial (acres)	Total Volume (MBF)	Volume by Species - (MBF)					
			WP	P	L-D	S	H-AF-GF	LP-WLP
IP8W	1,923	16,538	-	-	1,923	385	192	14,038
IP8M	4,843	15,982	-	-	-	5,328	1,453	9,201
IP8P	4,673	6,549	-	-	2,339	1,404	467	2,339
Total	11,439	39,069	-	-	4,262	7,117	2,112	25,578
AF9M	4,868	26,777	-	-	-	14,117	5,355	7,305
AF9P	12,837	70,610	-	-	-	25,681	19,255	25,674
Total	17,705	97,387	-	-	-	39,798	24,610	32,979
S9M	574	7,691	-	-	574	5,625	689	803
S9P	189	2,307	-	-	151	1,399	246	511
Total	763	9,998	-	-	725	7,024	935	1,314
<b>BLOCK TOTAL</b>	<b>29,907</b>	<b>146,454</b>	<b>-</b>	<b>-</b>	<b>4,987</b>	<b>53,939</b>	<b>27,657</b>	<b>59,871</b>



**NET VOLUME (PARTIAL CUBIC FEET) SAWTIMBER-SIZE TREES BY STRATA**  
**(Pole and Sawtimber Stands - Nonreserved National-Forest Lands)**

**Appendix Table 9**

**Big Timber Working Circle**

Strata	Stocked Commercial (acres)	Total Volume (MCF)	Volume by Species (MCF)					
			WP	P	L-D	S	H-AF-GF	LP-WLP
D9W	7,158	16,106	-	-	14,316	72	72	1,646
D9M	15,986	20,622	-	-	10,231	8,153	1,279	959
D9P	25,252	17,424	-	505	13,636	505	-	2,778
D8W	2,114	1,311	-	-	1,311	-	-	-
D8M	624	324	-	-	324	-	-	-
D8P	52	16	-	-	16	-	-	-
Total	51,186	55,803	-	505	39,834	8,730	1,351	5,383
P9P	521	427	-	318	109	-	-	-
LP8W	12,793	23,154	-	-	2,687	255	255	19,957
LP8M	10,528	7,264	-	-	-	2,316	737	4,211
LP8P	7,010	2,032	-	-	701	420	140	771
Total	30,331	32,450	-	-	3,388	2,991	1,132	24,939
AF9M	8,278	9,437	-	-	-	4,967	1,821	2,649
AF9P	23,709	27,028	-	-	-	9,484	7,349	10,195
Total	31,987	36,465	-	-	-	14,451	9,170	12,844
S9M	1,989	5,470	-	-	417	3,978	478	597
S9P	1,547	3,899	-	-	263	2,321	433	882
Total	3,536	9,369	-	-	680	6,299	911	1,479
GRAND TOTAL	117,561	134,514	-	823	44,011	32,471	12,564	44,645

**NET VOLUME (PARTIAL CUBIC FEET) SAWTIMBER-SIZE TREES BY STRATA  
(Pole and Sawtimber Stands - Nonreserved National-Forest Lands)**

**Appendix Table 9A**

**Big Timber Block**

Strata	Stocked Commercial (acres)	Total Volume (MCF)	Volume by Species - (MCF)					C
			WP	P	L-D	S	H-AF-GF	LP-WLP
D9W	7,158	16,106	-	-	14,316	72	72	1,646
D9M	15,986	20,622	-	-	10,231	8,153	1,279	959
D9P	25,252	17,424	-	505	13,636	505	-	2,778
D8W	2,114	1,311	-	-	1,311	-	-	-
D8M	624	324	-	-	324	-	-	-
D8P	52	16	-	-	16	-	-	-
Total	51,186	55,803	-	505	39,834	8,730	1,351	5,383
P9P	521	427	-	318	109	-	-	-
LP8W	10,870	19,674	-	-	2,283	217	217	16,957
LP8M	5,685	3,923	-	-	-	1,251	398	2,274
LP8P	2,337	678	-	-	234	140	47	257
Total	18,892	24,275	-	-	2,517	1,608	662	19,488
AF9M	3,410	3,887	-	-	-	2,046	750	1,091
AF9P	10,872	12,394	-	-	-	4,349	3,370	4,675
Total	14,282	16,281	-	-	-	6,395	4,120	5,766
S9M	1,415	3,892	-	-	297	2,830	340	425
S9P	1,358	3,422	-	-	231	2,037	380	774
Total	2,773	7,314	-	-	528	4,867	720	1,199
BLOCK TOTAL	87,654	104,100	-	823	42,988	21,600	6,853	31,836

NET VOLUME (PARTIAL CUBIC FEET) SAWTIMBER-SIZE TREES BY STRATA  
(Pole and Sawtimber Stands - Nonreserved National-Forest Lands)

Appendix Table 9B

Gardiner Block

Strata	Stocked Commercial (acres)	Total Volume (MCF)	Volume by Species - (MCF)					
			WP	P	L-D	S	H-AF-GF	LP-WLP
LP8W	1,923	3,480	-	-	404	38	38	3,000
LP8M	4,843	3,341	-	-	-	1,065	339	1,937
LP8P	4,673	1,354	-	-	467	280	93	514
Total	11,439	8,175	-	-	871	1,383	470	5,451
AF9M	4,868	5,550	-	-	-	2,921	1,071	1,558
AF9P	12,837	14,634	-	-	-	5,135	3,979	5,520
Total	17,705	20,184	-	-	-	8,056	5,050	7,078
S9M	574	1,578	-	-	120	1,148	138	172
S9P	189	477	-	-	32	284	53	108
Total	763	2,055	-	-	152	1,432	191	280
BLOCK TOTAL	29,907	30,414	-	-	1,023	10,871	5,711	12,809

**NET VOLUME (PARTIAL CUBIC FEET) POLETIMBER-SIZE TREES BY STRATA**  
**(Pole and Sawtimber Stands - Nonreserved National-Forest Lands)**

Appendix Table 10

Big Timber Working Circle

Strata	Stocked Commercial (acres)	Total Volume (MCF)	Volume by Species - (MCF)					
			WP	P	L-D	S	H-AF-GF	IP-WIP
D9W	7,158	7,441	-	-	6,871	-	-	570
D9M	15,986	8,799	-	-	4,637	2,401	1,280	481
D9P	25,252	12,639	-	-	8,845	509	-	3,285
D8W	2,114	1,543	-	-	1,543	-	-	-
D8M	624	324	-	-	324	-	-	-
D8P	52	24	-	-	24	-	-	-
Total	51,186	30,770	-	-	22,244	2,910	1,280	4,336
P9P	521	158	-	106	52	-	-	-
LP8W	12,793	17,278	-	-	896	1,794	1,918	12,670
LP8M	10,528	7,052	-	-	-	2,630	1,263	3,159
LP8P	7,010	4,356	-	-	138	351	351	3,516
Total	30,331	28,686	-	-	1,034	4,775	3,532	19,345
AF9M	8,278	6,703	-	-	-	3,311	3,311	81
AF9P	23,709	17,312	-	-	-	4,743	6,638	5,931
Total	31,987	24,015	-	-	-	8,054	9,949	6,012
S9M	1,989	1,153	-	-	79	657	398	19
S9P	1,547	1,146	-	-	-	620	464	62
Total	3,536	2,299	-	-	79	1,277	862	81
GRAND TOTAL	117,561	85,928	-	106	23,409	17,016	15,623	29,774



**NET VOLUME (PARTIAL CUBIC FEET) POLETIMBER-SIZE TREES BY STRATA**  
**(Pole and Sawtimber Stands - Nonreserved National-Forest Lands)**

Appendix Table 10A

Big Timber Block

Strata	Stocked Commercial (acres)	Total Volume (MCF)	Volume by Species - (MCF)					
			WP	P	L-D	S	H-AF-GF	LP-WLP
D9W	7,158	7,441	-	-	6,871	-	-	570
D9M	15,986	8,799	-	-	4,637	2,401	1,280	481
D9P	25,252	12,639	-	-	8,845	509	-	3,285
D8W	2,114	1,543	-	-	1,543	-	-	-
D8M	624	324	-	-	324	-	-	-
D8P	52	24	-	-	24	-	-	-
Total	51,186	30,770	-	-	22,244	2,910	1,280	4,336
P9P	521	158	-	106	52	-	-	-
IP8W	10,870	14,682	-	-	762	1,524	1,630	10,766
IP8M	5,685	3,809	-	-	-	1,421	682	1,706
IP8P	2,337	1,458	-	-	46	118	117	1,177
Total	18,892	19,949	-	-	808	3,063	2,429	13,649
AF9M	3,410	2,760	-	-	-	1,363	1,364	33
AF9P	10,872	7,940	-	-	-	2,175	3,044	2,721
Total	14,282	10,700	-	-	-	3,538	4,408	2,754
S9M	1,415	820	-	-	56	468	283	13
S9P	1,358	1,005	-	-	-	544	407	54
Total	2,773	1,825	-	-	56	1,012	690	67
BLOCK TOTAL	87,654	63,402	-	106	23,160	10,523	8,807	20,806

NET VOLUME (PARTIAL CUBIC FEET) POLETIMBER-SIZE TREES BY STRATA  
(Pole and Sawtimber Stands - Nonreserved National Forest Lands)

Appendix Table 10B

Gardiner Block

Strata	Stocked Commercial (acres)	Total Volume (MCF)	Volume by Species - (MCF)						
			WP	P	L-D	S	H-AF-GF	LP-WLP	C
LP8W	1,923	2,596	-	-	134	270	288	1,904	-
LP8M	4,843	3,243	-	-	-	1,209	581	1,453	-
LP8P	4,673	2,898	-	-	92	233	234	2,339	-
Total	11,439	8,737	-	-	226	1,712	1,103	5,696	-
AF9M	4,868	3,943	-	-	-	1,948	1,947	48	-
AF9P	12,837	9,372	-	-	-	2,568	3,594	3,210	-
Total	17,705	13,315	-	-	-	4,516	5,541	3,258	-
S9M	574	333	-	-	23	189	115	6	-
S9P	189	141	-	-	-	76	57	8	-
Total	763	474	-	-	23	265	172	14	-
BLOCK TOTAL	29,907	22,526	-	-	249	6,493	6,816	8,968	-

**NET VOLUME (PARTIAL CUBIC FEET) OF SAWTIMBER AND POLETIMBER-SIZE TREES BY STRATA**  
**(Pole and Sawtimber-Size Stands - Nonreserved National-Forest Land)**

Appendix Table 11

Big Timber Working Circle

Strata	Stocked Commercial (acres)	Total Volume (MCF)	Volume by Species - (MCF)					
			WP	P	L-D	S	H-AF-GF	LP-WLP
D9W	7,158	23,547	-	-	21,187	72	72	2,216
D9M	15,986	29,421	-	-	14,868	10,554	2,559	1,440
D9P	25,252	30,063	-	505	22,481	1,014	-	6,063
D8W	2,114	2,854	-	-	2,854	-	-	-
D8M	624	648	-	-	648	-	-	-
D8P	52	40	-	-	40	-	-	-
Total	51,186	86,573	-	505	62,078	11,640	2,631	9,719
P9P	521	585	-	424	161	-	-	-
LP8W	12,793	40,432	-	-	-	-	-	-
LP8M	10,528	14,316	-	-	3,583	2,049	2,173	32,627
LP8P	7,010	6,388	-	-	839	4,946	2,000	7,370
Total	30,331	61,136	-	-	4,422	7,766	4,664	44,284
AF9M	8,278	16,140	-	-	-	-	-	-
AF9P	23,709	44,340	-	-	-	8,278	5,132	2,730
Total	31,987	60,480	-	-	-	14,227	13,987	16,126
S9M	1,989	6,623	-	-	-	22,505	19,119	18,856
S9P	1,547	5,045	-	-	496	4,635	876	616
Total	3,536	11,668	-	-	263	2,941	897	944
Total			-	-	759	7,576	1,773	1,560
GRAND TOTAL	117,561	220,442	-	929	67,420	49,487	28,187	74,419

NET VOLUME (PARTIAL CUBIC FEET) OF SAWTIMBER AND POLETIMBER-SIZE TREES BY STRATA  
(Pole and Sawtimber-Size Stands - Nonreserved National-Forest Land)

Appendix Table 11A

Big Timber Block

Strata	Stocked Commercial (acres)	Total Volume (MCF)	Volume by Species - (MCF)					
			WP	P	L-D	S	H-AF-GF	LP-WLP
D9W	7,158	23,547	-	-	21,187	72	72	2,216
D9M	15,986	29,421	-	-	14,868	10,554	2,559	1,440
D9P	25,252	30,063	-	505	22,481	1,014	-	6,063
D8W	2,114	2,854	-	-	2,854	-	-	-
D8M	624	648	-	-	648	-	-	-
D8P	52	40	-	-	40	-	-	-
Total	51,186	86,573	-	505	62,078	11,640	2,631	9,719
P9P	521	585	-	424	161	-	-	-
LP8W	10,870	34,356	-	-	3,045	1,741	1,847	27,723
LP8M	5,685	7,732	-	-	-	2,672	1,080	3,980
LP8P	2,337	2,136	-	-	280	258	164	1,434
Total	18,892	44,224	-	-	3,325	4,671	3,091	33,137
AF9M	3,410	6,647	-	-	-	3,409	2,114	1,124
AF9P	10,872	20,334	-	-	-	6,524	6,414	7,396
Total	14,282	26,981	-	-	-	9,933	8,528	8,520
S9M	1,415	4,712	-	-	353	3,298	623	438
S9P	1,358	4,427	-	-	231	2,581	787	828
Total	2,773	9,139	-	-	584	5,879	1,410	1,266
BLOCK TOTAL	87,654	167,502	-	929	66,148	32,123	15,660	52,642



NET VOLUME (PARTIAL CUBIC FEET) OF SAWTIMBER AND POLETIMBER-SIZE TREES BY STRATA  
(Pole and Sawtimber-Size Stands - Nonreserved National-Forest Land)

Appendix Table 11B

Gardiner Block

Strata	Stocked Commercial. (acres)	Total Volume (MCF)	Volume by Species - (MCF)						
			WP	P	L-D	S	H-AF-GF	LP-WLP	C
LP8W	1,923	6,076	-	-	538	308	326	4,904	-
LP8M	4,843	6,584	-	-	-	2,274	920	3,390	-
LP8P	4,673	4,252	-	-	559	513	327	2,853	-
Total	11,439	16,912	-	-	1,097	3,095	1,573	11,147	-
AF9M	4,868	9,493	-	-	-	4,869	3,018	1,606	-
AF9P	12,837	24,006	-	-	-	7,703	7,573	8,730	-
Total	17,705	33,499	-	-	-	12,572	10,591	10,336	-
S9M	574	1,911	-	-	143	1,337	253	178	-
S9P	189	618	-	-	32	360	110	116	-
Total	763	2,529	-	-	175	1,697	363	294	-
BLOCK TOTAL	29,907	52,940	-	-	1,272	17,364	12,527	21,777	-

NET VOLUME (PARTIAL CUBIC FOOT) PER ACRE BY STRATA 1/

Nonreserved National-Forest Land

Appendix Table 12

Big Timber Working Circle

Strata	Species															
	PP				S				AF				LP			
	Saw	Pole	Saw	Pole	Saw	Pole	Saw	Pole	Saw	Pole	Saw	Pole	Saw	Pole	Saw	Pole
	Cubic Feet															
D9W	-	-	2,000	960	10	-	10	-	-	230	80	-	-	-	2,250	1,040
D9M	-	-	640	290	510	-	40	30	-	60	30	-	40	50	1,290	550
D9P	20	-	540	350	20	-	-	-	-	110	130	-	-	-	690	500
D8W	-	-	620	730	-	-	-	-	-	-	-	-	-	-	620	730
D8M	-	-	520	520	-	-	-	-	-	-	-	-	-	-	520	520
D8P	-	-	310	450	-	-	-	-	-	-	-	-	-	-	310	450
P9P	610	200	210	100	-	-	-	-	-	-	-	-	-	-	820	300
IP8W	-	-	210	70	20	-	20	140	150	1,390	890	170	100	-	1,810	1,350
IP8M	-	-	-	-	220	-	70	250	120	320	250	80	50	-	690	670
IP8P	-	-	100	20	60	-	20	50	50	80	300	30	200	-	290	620
AF9M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AF9P	-	-	-	-	600	-	220	400	400	300	10	20	-	-	1,140	810
S9M	-	-	210	40	2,000	-	240	330	280	380	250	50	-	-	1,140	730
S9P	-	-	170	-	1,500	-	280	400	300	500	40	70	-	-	2,750	580
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,520	740
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1/ Total Height Volume Tables, Intermountain Region 1957

NET VOLUME (BOARD FEET) PER ACRE BY STRATA <sup>1/</sup>  
Nonreserved National-Forest Land

Appendix Table 13

Big Timber Working Circle

Strata	Species							Total
	PP	DF	S	AF	LP	WLP	Hdw.	
	MBF							
D9W	-	9,600	100	-	1,100	-	-	10,800
D9M	-	3,100	2,500	200	300	-	200	6,300
D9P	100	2,600	100	-	500	-	-	3,300
D8W	-	3,000	-	-	-	-	-	3,000
D8M	-	2,500	-	-	-	-	-	2,500
D8P	-	1,500	-	-	-	-	-	1,500
P9P	3,000	1,000	-	-	-	-	-	4,000
LP8W	-	1,000	300	100	6,400	800	-	8,600
LP8M	-	-	1,100	300	1,500	400	-	3,300
LP8P	-	500	300	100	400	100	-	1,400
AF9M	-	-	2,900	1,100	1,400	100	-	5,500
AF9P	-	-	2,000	1,500	1,700	300	-	5,500
S9M	-	1,000	9,800	1,200	1,300	100	-	13,400
S9P	-	800	7,400	1,300	2,400	300	-	12,200

<sup>1/</sup> Total Height Volume Tables, Intermountain Region 1957

# CONVERTING FACTORS

## National-Forest Lands

### Appendix Table 14

### Big Timber Working Circle

#### a. Board Foot - Cubic Foot Ratios - Sawtimber-Size Trees:

<u>Species</u>	<u>Ratio</u>
PP	4.9
DF	4.8
S	4.9
AF & Co	4.8
LP	4.7

#### b. Board Foot - Cubic Foot Ratio for Pole-Size Trees:

2.5 Board Feet = 1 Cubic Foot

#### c. Cubic Foot - Cord Ratio for Pole-Size Trees:

90 Cubic Feet = 1 Cord

#### d. Board Foot - Cord Ratios:

##### 1. Sawtimber-Size Trees:

2 Cords = 1 M Board Feet

##### 2. Pole-Size Trees:

3 Cords = 1 M Board Feet



PERIODIC ANNUAL INCREMENT AND MORTALITY BY TYPES 1/  
POLE AND SAWTIMBER STANDS  
 (Nonreserved National-Forest Lands)

Appendix Table 15

Big Timber Working Circle

Forest Type	Com'l Forest Area (acres)	Gross PAI /acre (CF)	Mort. 2/ /acre (CF)	Net PAI /acre (CF)	Percent 3/ Volume Sawt.	Net PAI /acre Sawt. (CF)	Cu.Ft. Bd.Ft. Ratio	Mort. Sawt. /Ac. (BF)	Net Sawt. PAI/acre (BF)	Total	
										Sawt. (MBF)	Other (MCF)
DF-PP	51,707	27.1	3.9	23.2	64.6	15.0	8.2	12	72	620	424
S	3,536	36.0	10.0	26.0	80.7	21.0	5.0	39	103	137	18
LPP-AF	62,318	34.8	42.1	-3.7	57.2	-8.7 <sup>4/</sup>	5.0 <sup>4/</sup>	113	-41	7,042	312
TOTALS	117,561					13.0	6.4	66	13	7,799	754

1/ Based on average PAI past 10 years and average annual mortality past 5 years.

2/ From inventory plot data.

3/ From appendix tables 6 and 8.

4/ Estimated apportionment.

PRESENT MEAN ANNUAL INCREMENT BY TYPES  
(Nonreserved National-Forest Lands)

Appendix Table 16

Big Timber Working Circle

Forest Type	Com'l Forest Area (acres)	Sites (percent)	Actual Stocking (percent)	Mean Annual Increment 1/			
				Sawtimber (BF per acre)	Total (MBF)	Poletimber (CF per acre)	Total (MCF)
D-P	52,143	M-6 P-94	45	49	2,555	5.3	276
S	3,536	M-17 P-83	40	106	375	5.4	19
AF	31,987	M-17 P-83	33	45	1,439	6.2	198
LP	39,593	G-17 M-43 P-40	62	38	1,505	7.1	281
TOTAL	127,259				5,874		774

<sup>1/</sup> Normal MAI adjusted to present stocking or actual MAI.

SUSTAINED YIELD CAPACITY BY TYPES  
(Nonreserved National-Forest Lands)

Appendix Table 17

Big Timber Working Circle

Forest Type	Rotation (years)	Com'l Forest Area (acres)	Normal MAI/acre <u>1/</u>		Realizable MAI/acre <u>2/</u>		Total Normal		Total Realizable	
			Saw BF	Pole CF	Saw BF	Pole CF	Saw MBF	Pole MCF	Saw MBF	Pole MCF
D-P	160	52,143	105	28	73	20	5,475	1,460	3,806	1,042
S	140	3,536	160	39	112	27	566	138	396	95
AF	140	31,987	160	39	112	27	5,118	1,247	3,582	863
LP	120	39,593	127	23	89	16	5,028	911	3,524	633
TOTAL		127,259	127	30	89	21	16,187	3,756	11,308	2,633
							9,390 <u>3/</u> MBF		6,582 <u>3/</u>	

1/ From "Tables of Yields and Mean Annual Increment of Fully Stocked Stands in Major Forest Types of Region."

2/ 70 percent of normal.

3/ Conversion of cubic contents of pole-size material to board foot contents at ratio of 2.5.

AREA OF AGE CLASSES BY TYPES <sup>1/</sup>  
(Nonreserved Commercial National-Forest Lands)

Appendix Table 18

Big Timber Working Circle

Age Class	Major Forest Types in Acres				Total Acres
	D-P	LP	S	AF	
1- 20	11	1,720	-	-	1,731
21- 40	-	6,882	-	-	6,882
41- 60	3,103	6,066	-	-	9,169
61- 80	14,470	8,190	283	2,559	25,502
81-100	1,551	3,033	884	7,997	13,465
101-120	9,309	2,123	919	8,316	20,667
121-140	7,758	2,123	283	2,559	12,723
141-160	6,206	3,943	884	7,997	19,030
161-180	4,655	910	-	-	5,565
181-200	3,103	2,123	-	-	5,226
200+	1,552	1,820	283	2,559	6,214
Subtotal	51,718	38,933	3,536	31,987	126,174
Nonstock	425	660			1,085
TOTAL	52,143	39,593	3,536	31,987	127,259

<sup>1/</sup> From inventory plots sampled in 1960.



AREA BY SITE AND TYPE  
(Nonreserved Commercial National-Forest Lands)

Appendix Table 19

Big Timber Working Circle

Forest Type	Site		
	Good	Medium	Poor
	Percent		
D-P		6	94
LP	17	43	40
S-AF		17	83

LOG GRADES BY SPECIES  
(Nonreserved Commercial National-Forest Lands)

Appendix Table 20

Species	Log Grades			
	1	2	3	4
	Percent			
D		3	19	78
S			61	39
AF			41	59
LP		14	37	49

SALVABLE DEAD AND USABLE CULL  
(Nonreserved Commercial National-Forest Lands)

Appendix Table 21

Forest Type	Com'l Forest Area (acres)	Salvable Dead		Usable Cull		Total Usable (cords)
		Per Acre (cords)	Total (cords)	Per Acre (cords)	Total (cords)	
D-P	51,707	2	102,372	1.5	76,779	179,151
S	3,536	2	7,072	1	3,536	10,608
AF	31,987	3	95,961	1	31,987	127,948
LP	30,331	3	90,993	2	60,662	151,655
TOTAL	117,561		296,398		172,964	469,362

CALCULATION OF ANNUAL ALLOWABLE HARVEST CUT OF SAWTIMBER  
(Nonreserved National-Forest Commercial Forest Lands)

Appendix Table 22

Big Timber Working Circle

KEMP FORMULA

$$AAC = \left( \frac{7A_m + 5A_p + 3A_s + A_r}{4R} \right) V_m$$

$A_m$  = Area of sawtimber stands

$A_p$  = Area of pole stands

$A_s$  = Area of S&S stands

$A_r$  = Area restocking

AAC = Annual Allowable Cut

$R$  = Rotation

$4$  = Number of stands

$V_m$  = Ave. Vol./ac. sawtbr. stands

Douglas-fir & Ponderosa Pine Types

160-Year Rotation

$$\begin{aligned} \text{Annual Area Cut} &= (.0016 \times 425) + (.0047 \times 11) + (.0078 \times 2,790) + \\ &\quad (.0109 \times 48,917) \\ &= .6800 + .0517 + 21.7620 + 533.1953 \\ &= 555 \text{ acres} \end{aligned}$$

	<u>P</u>	<u>D</u>	Species <u>S</u> Sawtimber	<u>AF</u>	<u>LP</u>	<u>Total</u>
Stand per Acre (MBF)	.136	3.771	.883	.131	.518	5.439
Allowable Cut (MBF)	.75	2,093	490	73	287	3,018
			Other Products			
Stand per Acre (MCF)	.002	.417	.060	.026	.089	.594
Allowable Cut (MCF)	1	232	33	14	49	329
Allowable Cut (cords) $\frac{1}{4}$	11	2,578	367	155	544	3,655

Lodgepole Pine Type

120-Year Rotation

$$\begin{aligned} \text{Annual Area Cut} &= (.0021 \times 660) + (.0063 \times 8,602) + (.0103 \times 15,166) + \\ &\quad (.0146 \times 15,165) \\ &= 1.3860 + 54.1926 + 156.2098 + 221.4090 \\ &= 433 \text{ acres} \end{aligned}$$

	<u>P</u>	<u>D</u>	Species <u>S</u> Sawtimber	<u>AF</u>	<u>LP</u>	<u>Total</u>
Stand per Acre (MBF)	-	.538	.535	.169	3.855	5.097
Allowable Cut (MBF)	-	233	232	73	1,669	2,207
			Other Products			
Stand per Acre (CF)	-	.034	.157	.117	.638	.946
Allowable Cut (MCF)	-	15	68	51	276	410
Allowable Cut (cords) $\frac{1}{4}$	-	167	755	567	3,066	4,555

$\frac{1}{4}$  Conversion to cords using 90 cubic feet = 1 cord

# Appendix Table (continued)

## KEMP FORMULA

## Spruce Type

### 140-Year Rotation

$$\begin{aligned}\text{Annual Area Cut} &= (.0018 \times 0) + (.0054 \times 0) + (.0089 \times 0) + (.0125 \times 3,536) \\ &= 0 + 0 + 0 + 44.200 \\ &= 44 \text{ acres}\end{aligned}$$

	<u>Species</u>					<u>Total</u>
	<u>P</u>	<u>D</u>	<u>S</u>	<u>AF</u>	<u>LP</u>	
			<u>Sawtimber</u>			
Stand per Acre (MBF)	-	.912	8.750	1.244	1.969	12.875
Allowable Cut (MBF)	-	40	385	55	87	567
			<u>Other Products</u>			
Stand per Acre (MCF)	-	.022	.361	.244	.023	.650
Allowable Cut (MCF)	-	1	16	11	1	29
Allowable Cut (cords) <u>1/</u>	-	11	178	122	11	322

## Alpine Fir Type

### 140-Year Rotation

$$\begin{aligned}\text{Annual Area Cut} &= (.0018 \times 0) + (.0054 \times 0) + (.0089 \times 0) + (.0125 \times 31,987) \\ &= 0 + 0 + 0 + 399.837 \\ &= 400 \text{ acres}\end{aligned}$$

	<u>Species</u>					<u>Total</u>
	<u>P</u>	<u>D</u>	<u>S</u>	<u>AF</u>	<u>LP</u>	
			<u>Sawtimber</u>			
Stand per Acre (MBF)	-	-	2.233	1.396	1.871	5.500
Allowable Cut (MBF)	-	-	894	558	748	2,200
			<u>Other Products</u>			
Stand per Acre (MCF)	-	-	.251	.311	.188	.750
Allowable Cut (MCF)	-	-	100	125	75	300
Allowable Cut (cords)	-	-	1,111	1,389	833	3,333

Average Cutting Area - 1,432 acres

Totals - 7,992 MBF (Sawtimber)  
1,068 MCF  
11,865 Cords (Other Products)

1/ Conversion to cords at 90 cubic feet = 1 cord

CALCULATION OF ANNUAL ALLOWABLE HARVEST CUT OF SAWTIMBER  
(Nonreserved National-Forest Commercial Forest Lands)

Appendix Table 23

Big Timber Working Circle

VON MANTZEL FORMULA

$$AAC = \frac{2 Ga}{R}$$

AAC = Allowable annual cut

Ga = Volume of actual growing stock

R = Rotation age

Type	Rotation	Annual Allowable Cut		
		Sawtimber	Other Products	
D-P	160	$\frac{2 \times 56,230}{160} = 703 \text{ MCF}$ $703 \text{ MCF} \times .653 \frac{1}{2} = 459 \text{ MCF}$ $459 \times 4.8 = 2,203 \text{ MBF}$	244 MCF or 2,711 cords $\frac{2}{2}$	
IP	120	$\frac{2 \times 61,136}{120} = 1,019 \text{ MCF}$ $1,019 \text{ MCF} \times .531 = 541 \text{ MCF}$ $541 \times 4.7 = 2,543 \text{ MBF}$	478 MCF or 5,310 cords $\frac{2}{2}$	
S	140	$\frac{2 \times 11,668}{140} = 167 \text{ MCF}$ $167 \text{ MCF} \times .803 = 134 \text{ MCF}$ $134 \times 4.9 = 657 \text{ MBF}$	33 MCF or 367 cords $\frac{2}{2}$	
AF	140	$\frac{2 \times 60,480}{140} = 864 \text{ MCF}$ $864 \text{ MCF} \times .603 = 521 \text{ MCF}$ $521 \times 4.8 = 2,500 \text{ MBF}$	343 MCF or 3,810 cords $\frac{2}{2}$	
TOTALS		7,903 MBF	1,098 MCF or 12,198 cords	

$\frac{1}{2}$  Percent sawtimber of total cubic contents in sawtimber strata  
 $\frac{2}{90}$  cubic feet = 1 cord



CALCULATION OF ANNUAL ALLOWABLE HARVEST CUT OF SAWTIMBER  
(Nonreserved National-Forest Commercial Forest Lands)

Appendix Table 24

Big Timber Working Circle

HANZLIK FORMULA

$$AAC = \frac{V_m + I}{R}$$

$V_m$  = Volume of sawtimber over rotation age  
 $R$  = Rotation  
 $I$  = Mean annual increment

		Annual Allowable Cut		
Type	Rotation	Sawtimber	Other Products	
D-P	160	$\frac{52,069}{160} + 2,555 = 2,880$ MBF	276 MCF or 3,066 cords	
LP	120	$\frac{142,848}{120} + 1,505 = 2,695$ MBF	281 MCF or 3,123 cords	
S	140	$\frac{15,024}{140} + 375 = 482$ MBF	19 MCF or 211 cords	
AF	140	$\frac{58,064}{140} + 1,439 = 1,854$ MBF	198 MCF or 2,200 cords	
TOTAL		7,911 MBF	774 MCF or 8,600 cords	

(continued on next page)

Appendix Table 24 (continued)

VOLUME OF GROWING STOCK (SAWTIMBER) OVER ROTATION AGE

HANZLIK FORMULA

Forest Type	Area of Sawtimber acres	Area Over Rotation Age acres	Area Over Rotation Age percent	Sawtimber Volume	
				Total Growing Stock MBF	Over Rotation Age MBF
D-P	48,917	9,310	19.0	274,047	52,069
IP	15,165	14,015	92.4	154,598	142,848
S	3,536	1,167	33.0	45,527	15,024
AF	31,987	10,556	33.0	175,951	58,064
TOTAL	99,605	35,048		650,123	268,005

CALCULATION OF ANNUAL ALLOWABLE HARVEST CUT OF SAWTIMBER  
(Nonreserved National-Forest Commercial Forest Lands)

Appendix Table 25

Big Timber Working Circle

AUSTRIAN FORMULA

$$AAC = I + \frac{Ga - Gr}{a}$$

I = Mean annual increment  
Ga = Actual growing stock  
Gr = Realizable growing stock (70% normal)  
a = Rotation for adjustment period

-----  
Types: Douglas-fir and Ponderosa Pine

Rotation: 160 yrs.

Age Group:	<u>20</u>	<u>40</u>	<u>60</u>	<u>80</u>	<u>100</u>	<u>120</u>	<u>140</u>	<u>160</u>	<u>Total</u>
Normal Yield :	-	-	142	2,174	5,125	8,718	13,070	7,761	36,990
(BF Scribner)								(1/2 Normal)	

$$Gr = \frac{36,990 \times .70 \times 20}{160} = 3,237/\text{acre}$$

$$Gr = 3,237 \times 52,143 = 168,786 \text{ MBF}$$

$$AAC = 2,555 + \frac{266,064 - 168,786}{160} = 3,163 \text{ MBF}$$

-----  
Type: Lodgepole Pine

Rotation: 120 yrs.

Age Group:	<u>20</u>	<u>40</u>	<u>60</u>	<u>80</u>	<u>100</u>	<u>120</u>	<u>Total</u>
Normal Yield:							
(Cubic Feet)							

Poor - 40%	-	200	1220	2350	3230	1925	
Medium - 43%	-	410	2000	3400	4600	2800	
Good - 17%	-	945	3150	5200	6520	3700(1/2)	
Weight Yield	-	417	1883	3286	4378	2603	12,567

$$Gr = \frac{12,567 \times .70 \times 20}{120} = 1,466/\text{acre}$$

$$Gr = 1,466 \times 39,593 = 58,043 \text{ MCF (Total)}$$

$$Gr = 58,043 \times .53 = 30,763 \text{ MCF (sawtimber trees)}$$

$$Gr = 30,763 \times 4.7 = 144,860 \text{ MBF (sawtimber trees)}$$

$$AAC = 1,505 + \frac{154,598 - 144,860}{120} = 1,586 \text{ MBF}$$

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(Continued on next page)

Appendix Table 25 (continued)Big Timber Working CircleAUSTRIAN FORMULATypes: Spruce-Alpine FirRotation: 140 years

Age Group:	<u>20</u>	<u>40</u>	<u>60</u>	<u>80</u>	<u>100</u>	<u>120</u>	<u>140</u>	<u>Total</u>
Normal Yield: (BF Scribner)	76	170	3315	11020	20117	12950	(1/2 norm.)	47648

$$Gr = \frac{47648 \times .70 \times 20}{140} = 4765/\text{acre}$$

$$Gr = 4765 \times 2773 = 13213 \text{ MBF (Spruce Type)}$$

$$Gr = 4765 \times 14282 = 68,054 \text{ MBF (Alpine Fir Type)}$$

$$\text{Spruce: AAC} = 375 \times \frac{45527 - 13,213}{140} = 606 \text{ MBF}$$

$$\text{Alpine Fir AAC} = 1439 + \frac{175951 - 68054}{140} = 2210 \text{ MBF}$$

$$\text{TOTAL AAC: } 7,565 \text{ MBF}$$

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CALCULATION OF ANNUAL ALLOWABLE HARVEST CUT OF SAWTIMBER  
(Nonreserved National-Forest Commercial Forest Lands)

Appendix Table 26

Big Timber Working Circle

TABULAR CHECK

Tentative AAC: 8 MMBF      Average Rotation: 142 yrs.      Forest Types: All

Present Age Group (years)	Average Cutting Age (years)	Com'l Forest Area (acres)	PAI or MAI (BF)	Vol./ac. at Ave. Cutting Age (BF)	Total Volume to Cut (MMBF)	Years to Cut		Area Cut per Year (acres)
						Each Age Group (yrs)	Cumulative (years)	
200+	203			Res-6300	39.1			
	200-205	6214	13 <sup>1/</sup>	Gr- 52	.3	5	5	1243
190	197			Res-6300	32.9			
	195-199	5226	13	Gr- 91	.5	4	9	1306
170	181			Res-6300	35.1			
	179-184	5565	13	Gr- 143	.8	4	13	1391
150	171			Res-6300	119.9			
	163-179	19030	13	Gr- 286	5.2	16	29	1189
130	164			Res-6300	80.2			
	159-170	12723	13	Gr- 455	5.8	11	40	1157
110	162			Res-6300	130.2			
	150-174	20667	51	Gr- 2652	54.8	24	64	861
90	162			Res-6300	84.8			
	154-171	13465	51	Gr- 3672	49.4	17	83	792
70	168	Saw 16715		Res-4563	116.4			
	153-184	Pole 8787	51	Gr- 5049	128.7	31	114	822
50	170			Res-1258	11.5			
	164-177	9169	89 <sup>2/</sup>	Gr-10680	97.9	13	127	705
30	162			Res- 0	0			
	157-167	6882	89	Gr-11748	80.8	10	137	688
10	148			Res- 0	0			
	147-150	1731	89	Gr-12371	21.4	3	140	577
Restock	140			Res- 0	0			
	140-141	213	89	Gr-12549	2.7	1	141	213

1/ PAI from appendix table 15.

2/ MAI from appendix table 16.

# ANNUAL ALLOWABLE CUTS FROM INTERMEDIATE CUTTINGS

## National-forest Lands

Appendix Table 27

## Big Timber Working Circle

Well-Stocked Stands	Commercial Forest Area <u>acres</u>	Portion Under Rotation Age <u>percent</u>	Area Subject to Intermediate Cuts <u>acres</u>	Area that May be Cut Annually <u>acres</u>
<u>Sawtimber</u>				
D9W	7,158	81	5,798	290
<u>Pole</u>				
D8W	2,114	100	2,114	106
LP8W	12,793	64	8,187	409
TOTAL	22,065			805

## VOLUMES PER ACRE AVAILABLE FROM CUTTING AREAS

Well-Stocked Stands by Strata	Volumes per Acre		Recommended Cut <sup>1/</sup> <u>percent</u>	Volume of Cut per Acre		
	<u>Sawtimber</u> <u>MBF</u>	<u>Other</u> <u>MCF</u>		<u>Sawtimber</u> <u>MBF</u>	<u>Other Products</u> <u>MCF or cords</u> <sup>2/</sup>	
<u>Sawtimber</u>						
D9W	10.8	1.04	25	2.70	.26	2.9
<u>Pole</u>						
D8W	3.0	.73	25	.75	.18	2.0
LP8W	8.6	1.35	25	2.15	.34	3.8

<sup>1/</sup> Percentage of cut most appropriate for stands tending to be overstocked.

<sup>2/</sup> 90 cubic feet = 1 cord.

## INDICATED ANNUAL CUT FROM INTERMEDIATE CUTTINGS

Well-Stocked Strata	Area to Cut Annually <u>acres</u>	Volumes	
		<u>Sawtimber</u> <u>MBF</u>	<u>Other Products</u> <u>MCF or cords</u>
<u>Sawtimber</u>			
D9W	290	783	75 841
<u>Pole</u>			
D8W	106	79	19 212
LP8W	409	878	139 155
TOTAL	805	1,740	233 1,208

CORRELATED SUMMARY OF ESTIMATED TIMBER HARVEST AND SALES PROGRAM  
(Reference FSH 24.12.5)

Appendix Table 28

Gallatin National Forest

January 26, 1961

Working circle	Prod-uct	In millions of board feet																
		Total allow-able cut	Status of cumula-tive cut	Actual cut and sold, first half FY 1961	Last half FY 1961		Distribution of estimated cut and sell											
							Fiscal year											
							1962		1963		1964		1965		1966			
		Sold	Cut	Sell	Cut	Sell	Cut	Sell	Cut	Sell	Cut	Sell	Cut	Sell	Cut			
Big Timber	11 <sup>m</sup> +	* 8.0	1.0	-	0.1	-	0.2	2.9	0.5	2.3	1.4	7.8	1.8	2.8	3.0	2.8	3.8	
	11 <sup>m</sup> -	4.0	1.0	0.1	0.2	0.1	0.1	2.8	0.5	2.2	1.3	7.7	1.7	2.7	3.0	2.7	3.7	
	Total	12.0	2.0	0.1	0.3	0.1	0.3	5.7	1.0	4.5	2.7	15.5	3.5	5.5	6.0	5.5	7.5	

\* Changed to agree with calculated allowable cuts.

UNCUT VOLUME UNDER CONTRACT AVAILABLE FOR CUTTING  
(Reference FSH 2412.5)

Appendix Table 29

Forest: Gallatin

District: Big Timber D-1

Working circle: Big Timber

Date: January 12, 1961

Com- part- ment no.	Name of Sale	Date Sold	In millions of board feet					
			Total volume of sale	Uncut volume		Distribution of uncut balance		
				Total volume	Volume marked	Volume scaled	1/1/61 to 6/30/61	FY 1962 FY 1963 FY 1964 FY 1965 FY 1966
114	Derby Gulch	12/8/59	0.6	0.3		0.3	0.3	



PROPOSED CUT AND SELL PLANS <sup>1/</sup>  
(Reference FSH 2412.5)

Appendix Table 30

Forest: Gallatin

District: Big Timber

Working circle: Big Timber

Date: January 12, 1961

Com- part- ment No.	Name of Sale	In millions of board feet											
		Last half FY 1961		FY 1962		FY 1963		FY 1964		FY 1965		FY 1966	
		Sell	Cut	Sell	Cut	Sell	Cut	Sell	Cut	Sell	Cut	Sell	Cut
126	East Boulder			5.0	0.5		1.0		1.0		1.0		1.0
114	Derby Creek			0.2			0.2						
115	Main Bridger					4.0	1.0		1.0		1.0		1.0
161	Davis Creek							15.0	1.0		3.0		3.0
161	West Boulder									5.0	.5		2.0
144	Meatrack Creek											5.0	
	Misc. small sales	.1	.1	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
	TOTAL	.1	.1	5.7	1.0	4.5	2.7	15.5	3.5	5.5	6.0	5.5	7.5

<sup>1/</sup> All major sales deferred until an adequate system of access roads are constructed.

TIMBER ACCESS ROADS--DETAILS BY PROJECTS

Appendix Table 31

Forest: Gallatin      Working circle: Big Timber      District: Big Timber      Date: January 12, 1961

Com-part-ment No.	Name of sale	Road Proj-ect No.	Kind of Work Planned	Planned FY '62		Proposed FY '63		Proposed FY '64		Road survey	
				Estimated Cost (M\$)	Govt. Mi.	Estimated Cost (M\$)	Govt. Mi.	Estimated Cost (M\$)	Govt. Mi.	Type Planned Survey	Date of Completion
126	East Boulder	205	C, Cu	50.0	5.0					1	1 3/60
161	Davis Creek	35.2 7245	C, Cu C, Cu					28.0	2.0	1	11/30/62 4/30/63
161	West Boulder	35.2	C, Cu					15.0	2.0	1	4/30/63
144	Meatrack Cr. First sale as road is constructed up Main Boulder	212	R, Cu, S			10.0	10.0	470	470		

RIGHT-OF-WAY ACQUISITION INVENTORY AND PLAN  
(Reference FSH 5407.3, supplement)

Appendix Table 32

Forest: Gallatin

Fiscal year: 1962

Working circle: Big Timber

Project Name	Num- ber	Miles of Construction or Recon- struction*	Number of Right- of Way Cases		Cooperative Cost- sharing Agreement Needed--yes or no; Name of Company or Agency	Miles of Right- of-Way Survey Com- Remain- pleted   ing	Route Selected, yes or no	Estimated Construc- tion Cost
			Attorney General	Office of General Counsel				
West Boulder	35.2	2.0	1		No	1	No	15,000
Main Boulder	212	10.0	10		No	10	Yes	470,000
Main Boulder	212	41.9	17	5	No	29.7		557,500
<u>Existing Roads</u>								
West Bridger	488	5.0		2		1	Yes	
Derby Gulch	6674	3.0		1		1	Yes	

\* Forest Service construction responsibility.

TABLE 33 - FIVE-YEAR RIGHT-OF-WAY ACQUISITION PLAN

1962 through 1966

Proposed Sale	Road Name & Number	General Location of Right-of-Way	Landowner	Date of Construction
Derby Creek	Derby Creek 6674	Sec. 25, T2S, R15E	Fleming	1962
Main Bridger	Main Bridger	Sec. 18, T3S, R16E Main Bridger Creek	Davis	1963
Davis Creek	West Boulder 35.2	Sec. 25, T3S, R11E	Reid	1964
West Boulder	West Boulder 35.2	Sec. 25, T3S, R11E	Reid	1965
Meatrack	Main Boulder 212	Main Boulder River	32 owners	1966



OWNERSHIP PATTERN  
BIG TIMBER WORKING CIRCLE  
GALLATIN NATIONAL FOREST



LEGEND

- NATIONAL FOREST LAND
- ALIENATED LAND

◇ BIG TIMBER

◇ LIVINGSTON








MAJOR LAND CLASSES

BIG TIMBER WORKING CIRCLE  
GALLATIN NATIONAL FOREST

LEGEND

-  COMMERCIAL FOREST
-  NONCOMMERCIAL FOREST
-  NONFOREST



 BIG TIMBER

 LIVINGSTON







The following from the original has not been reproduced:

Map showing Compartments





